American Machinist

MAY 8, 1935

Washington Navy Yard

ROBERT J. WALKER
Lieutenant Commander,
United States Navy

and

WILLIAM K. MENDENHALL
Lieutenant,
United States Navy

A Deed

This Indenture, made the seventeenth day of March, in the year one thousand eight hundred, between Gustavus Scott and William Thornton, two of the Commissioners appointed by virtue of the act of Congress entitled "An act for establishing the temporary and permanent seat of the Government of the United States," of the one part, and the said United States of the other part, witnesseth that the said Gustavus Scott and William Thornton, Commissioners as aforesaid, for and in consideration of the sum of four thousand dollars, to them in hand paid by the Secretary of the Navy of said States before the ensealing and delivery of these presents the receipt whereof they do hereby acknowledge, have granted, bargained, sold, aliened, released, and confirmed, and by these presents do grant, bargain, sell, alien, release, and confirm unto the said United States forever, all those squares, pieces or parcels of ground in the city of Washington, District of Columbia, known and distinguished on the plan of said city by the number "eight hundred and eighty-three" and "eight hundred and eighty-four," together with all and singular the rights, privileges, benefits, and advantages to the same belonging or in any wise appertaining—

To have and to hold the said two squares, pieces, or parcels of ground and premises, with the appurtenances, unto the said United States forever, to the sole use and behoof of the said United States forever.

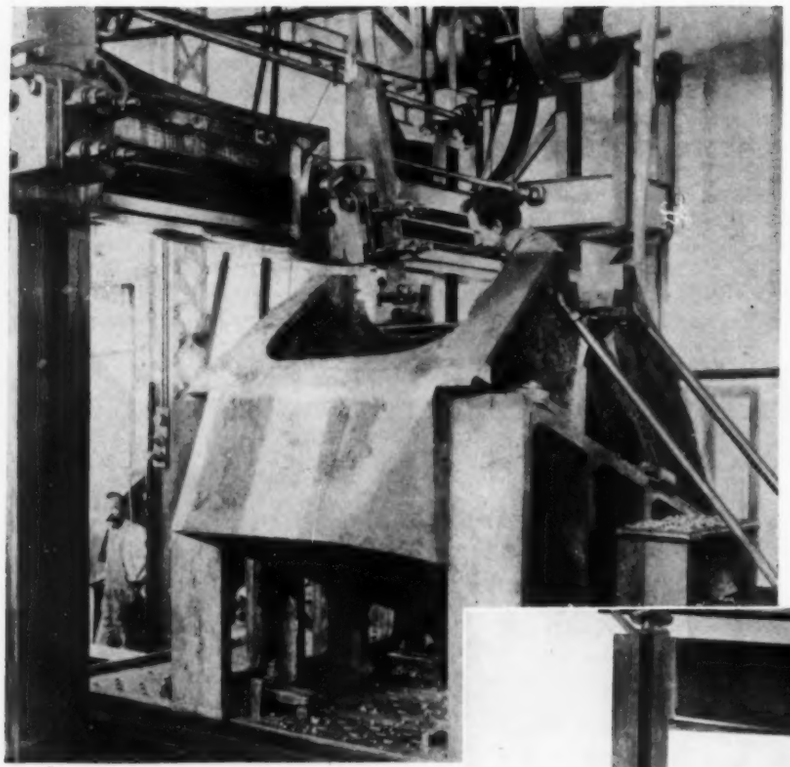
In Witness Whereof the said Gustavus Scott and William Thornton, Commissioners aforesaid, have hereunto set their hands and affixed their seals the day and year within written.

GUST'S SCOTT (Seal)
WILLIAM THORNTON (Seal)

ON THE LEFT appears a copy of the original deed, drawn when the United States government acquired title to the site of the Washington Navy Yard. Thus was born one of our navy yards which now has developed into the nation's naval arsenal.

The yard was designed originally "for capacious building and dock yard" and for many years was regarded as one of the best defended and most important of the Navy's shore activities. By the end of 1801 the government had expended $54,683 in improvements there, a sum greatly in excess of that appropriated at any one of the other navy yards. During the following year timber, stores and other materials were purchased to the extent of $158,683 for the building of a 74-gun ship; which fact only confirms the old story about George Washington throwing a dollar across the Potomac River at Mount Vernon for a dollar went further in those days than it does now.

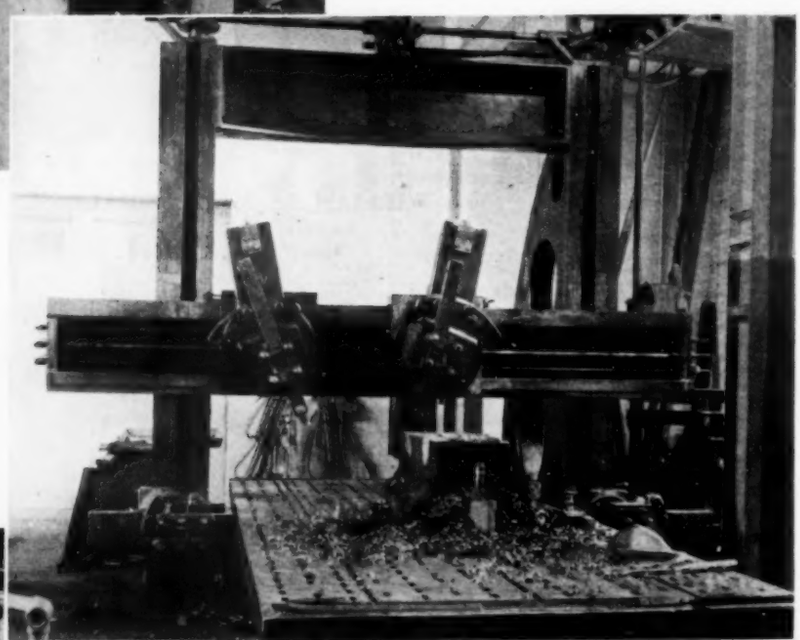
It is of current interest to note that in 1877 the hours of labor at navy yards were given as follows: March 21 to September 21, from 7 a.m. to 6 p.m., and September 22 to March 20, 7:40 a.m. to 4:30 p.m., with the usual hour

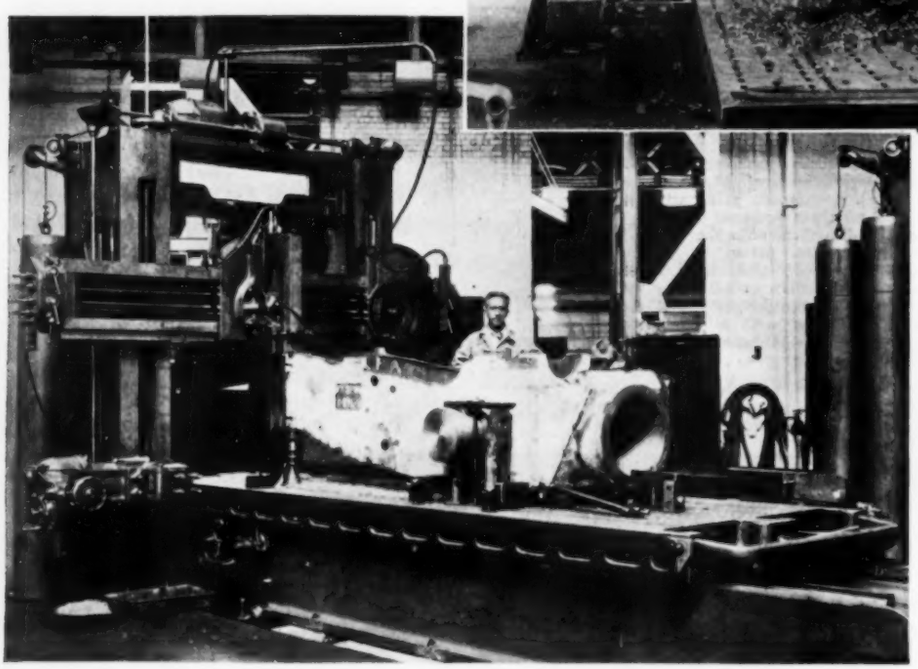


The old planers are faithful servants and their endurance testifies to the integrity of their manufacturers. Even so, they are too frail and lightly powered for modern needs and the work done on them could be done better and faster on a smaller number of up-to-date tools

for dinner. It was not until 1880 that telephones were installed, but this was only on trial, and it required several years to convince the authorities that they were necessary. Nor was it until 1889 that a railroad track was run into the yard. Prior to that, transportation of heavy material depended almost entirely upon oxen.

After the Civil War the yard gradually declined in importance as a shipyard; but owing largely to the original impetus given it by Commander Dahlgren, who took command in 1861, the ordnance department held its own and at intervals made rapid progress. In April, 1883, by an act of Congress, a gun foundry board was appointed by the President and, after visiting Great Britain and the continent, recommended two government gun factories,





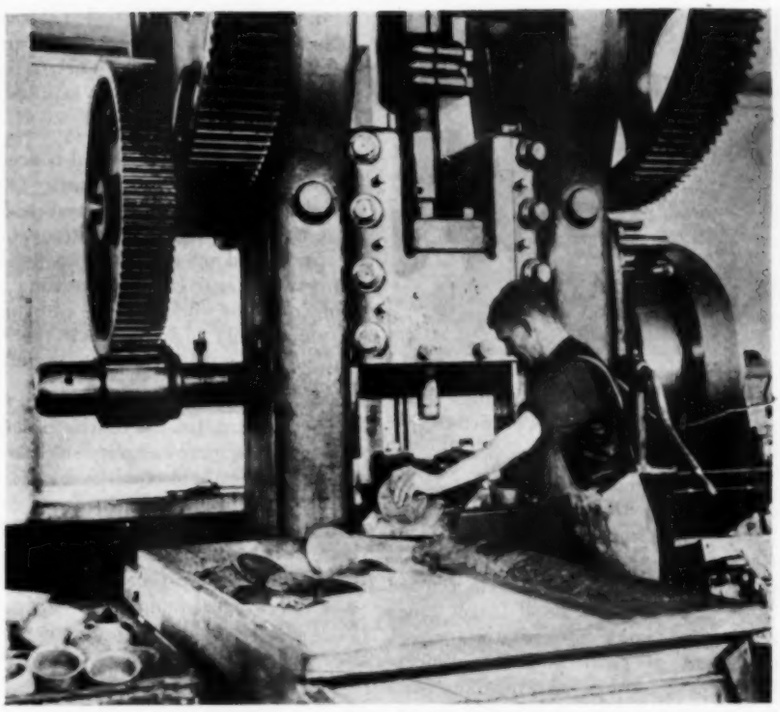
Modern planers are expensive machine tools but they earn their cost very soon in comparison with the old relics that encumber the Naval Gun Factory. Every Naval shop could use many more tools of this kind

one for the Army and one for the Navy, the one for the Navy to be at Washington. Finally, on August 14, 1886, by order of Secretary of the Navy Whitney, the yard was turned over for ordnance purposes.

Just prior to and during the World War the gun factory was provided by Congress with funds for the replacement of much of the obsolete and worn out machinery which was at that time in use. A new gun shop and a five-story machine shop were built and partially equipped with modern machinery. Prior to our entry into that War, the machine tool builders had for some time been taxed to provide European and American munition makers with machine tools. The mass production and speed of delivery demanded undoubtedly forced manufacturers to deliver machines in those exciting days that they would not now allow to go out of their plants.

So today, on a plot of ground which originally cost $4,000, we have $40,000,000 worth of buildings and equipment. The question arises: "Is this equipment sufficiently modern to work to the close tolerances being demanded?"

When a man-of-war falls out of formation at sea, the first person sent for by the skipper is the chief engineer. It is he who has to explain the cause of the casualty, but if that ship is engaged in target practice and one or more guns fail to fire on time, or there are not enough holes in the target at ten, fifteen, twenty, twenty-five thousands yards range, it is the gunnery officer who must explain.



This old press with its driving pinion supported largely by the atmosphere is still in use despite its unfitness

Such failures may result from improperly trained personnel; however, with the exacting standard set for officers and men along with the intensive yearly training the number of casualties and failures caused by the human element is kept to a minimum.

Improper design of guns or electromechanical equipment may occasionally be responsible for a poor target practice. In such cases immediate steps are taken to correct the fault and benefit by experience in future designs.

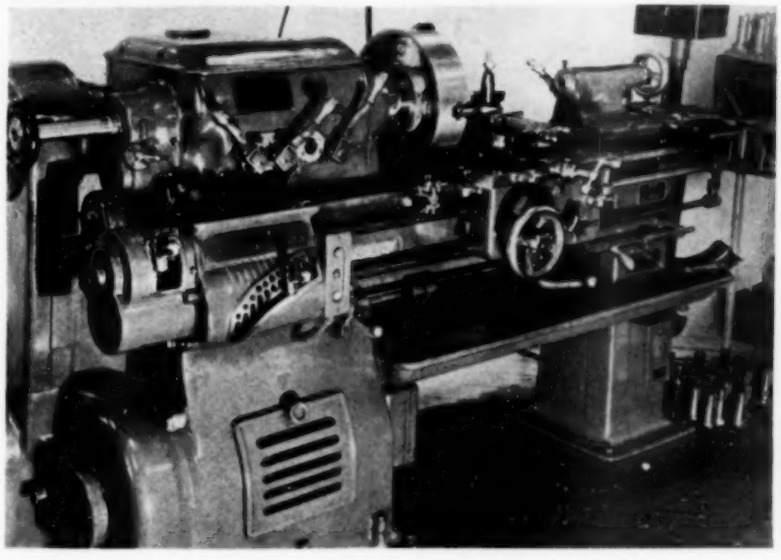
Old age, as we all know, results in many mechanical and electrical casualties. Fortunately, a strong rebuilding program offsets trouble of this kind.

There is one type of casualty which must be continuously guarded against and that is the one caused by inferior quality material, material which has been poorly or improperly made or worked or both.

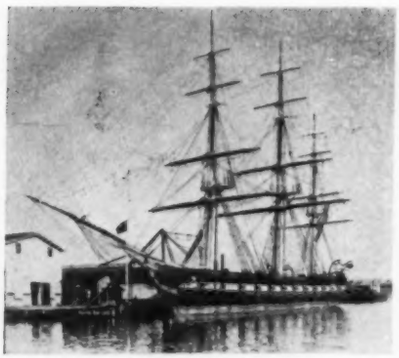
The great majority of our ordnance material, from the casting to the completed gun or turret mount, is now being manufactured at the Washington Yard and the extreme importance to the Navy, and to the country, of this equipment requires that the products of this yard be of the highest type.

In order to control the chemical analysis of the castings the furnaces in this yard must be of the right type and right size. If they are not their output will be inferior and weak. The normalizing furnaces have to be controlled within exact temperature limits or the work which passes through them will be subject to strains or in case the temperatures get too high a burned and poor product will result.

For the heat-treating department the demands are ever increasing. The old oil- and gas-fired furnaces in many cases must be replaced with electrical



A few such modern lathes are to be found in the Naval Gun Factory. Many more are badly needed



ones so as to control the high temperatures within a four- or five-degree limit.

It is common practice today to aim and fire the guns on a modern man-of-war from one station. This station is sometimes over 300 ft. away from its furthest gun. To require those guns to hit a small target miles and miles away necessitates perfect alignment of parts and the elimination of lost motion. To machine such parts requires accurate machine tools, tools which can remove metal at times with an allowed tolerance of less than 0.0005 in.

Then again, these machine tools must be modern for the labor cost of operating old and obsolete equipment is disproportionately high. Modern tools remove many times more metal per hour than old ones. Their adjustments and cutting speeds can be set more easily and quickly.

Accurate size control is also accomplished with much less hazard. Often a finishing operation designed to impart the last degree of accuracy must be performed on an otherwise finished component, and the loss in time and money due to work spoilage can run to extraordinarily high figures if the hazard of inaccurate sizing is permitted to operate.

Let us turn briefly to the practices of one of the more progressive commercial concerns of this country in keeping their plant modernized, namely the Blanchard Machine Company. Their policy of continuous replacement is particularly interesting and suggestive. The following is quoted from their own brief (*AM*—Vol. 75, page 798) which was submitted for the *American Machinist Award* of 1931.

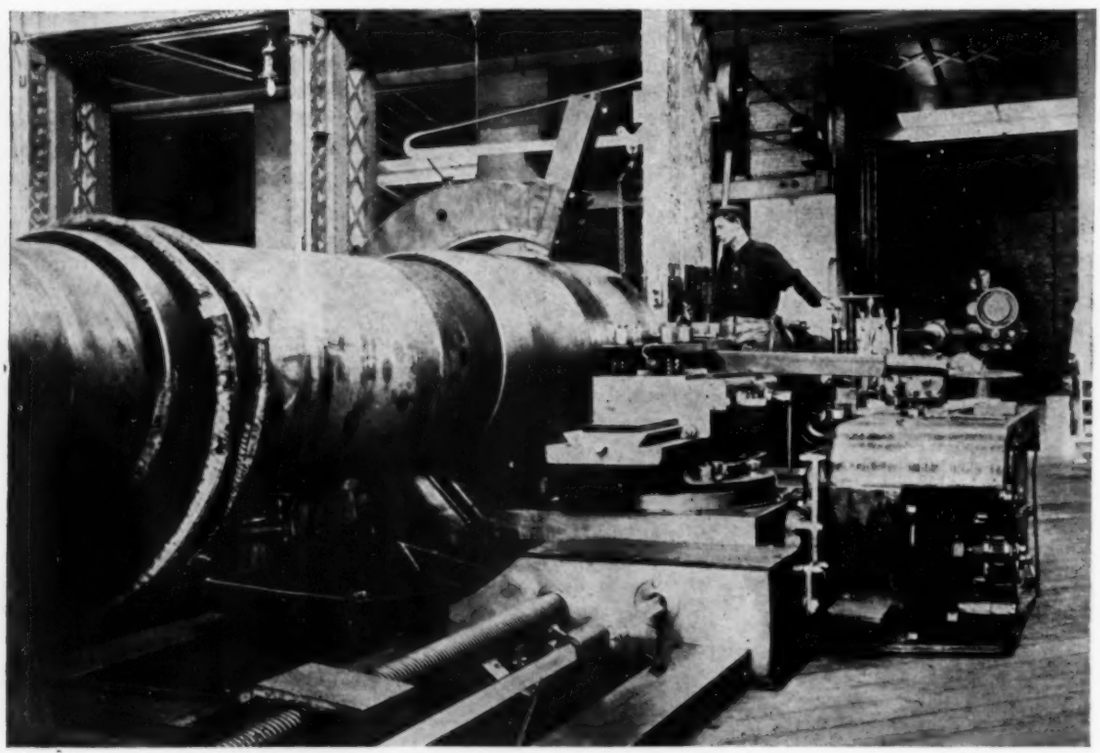
"The replacement policy of the Blanchard Machine Company is to purchase in each year new machine tools amounting in price to a least ten per cent of the replacement price of all its machine tools. Extensions of plant are in addition; the ten per cent is replacement only. This policy was adopted in 1923 . . ."

Typical condition of the shops at the Gun Factory may be seen by the accompanying illustrations or a visit to Washington.

An effort is being made to do away with all overhead belting. Not only is overhead belting hazardous but it cuts down on the efficient lighting of shops and is costly to maintain. Present policy dictates buying all new equipment with individual motor drive so that when the machine is not in operation no current is required for moving of belting and shafting.

Unproductive Machines

The machine tool industry is continually striving to improve its products. Closer tolerances, safety and greater ease and speed of operation are demanded by users of such equipment. Machines that are belt driven are not the only ones that are becoming obsolete. Manufacturers realize that it is profitable to replace equipment which can no longer take heavy cuts and so must the Navy. There are too many machines at the Gun Factory which can only do a half to a third of the amount of work that a new machine can accomplish.



As gun lathes go this is about the average. Its age can be guessed from the fact that no new ones have been installed since the war

The following table shows the ages of machine tools at the Gun Factory:

Age	Under 5 Yrs.	5-Yrs. Old	6–10 Yrs.	11–15 Yrs.	16–20 Yrs.	20–45 Yrs.	Total
Number of machines...	76	76	44	2094	469	711	3470
Per cent of total.....	2.19	2.19	1.27	60.35	13.5	20.5	100

The initial cost of the machine tools now at the Naval Gun Factory amounts to $15,434,048; the appraised value is $1,867,555, which illustrates the fact that very little has been spent in recent years. For accounting purposes the above appraised value is arrived at by a five per cent annual depreciation. In fact money actually appropriated for new machine tools in the past eleven months has averaged but $38,818 per year. If such a small yearly sum is to be used in the future it will require 397 years to replace the equipment at this yard. Incidentally, the Paymaster General's report shows that the equipment at Washington is older than at any other large Navy Yard, yet the work required of it is the most exacting.

Two sums of money have been requested from P.W.A. funds recently appropriated by Congress for emergency relief work. One sum of $1,500,000 to replace machine tool equipment urgently needed at Washington, and another sum of $5,000,000 to replace equipment which is no longer economical to operate. Though these sums appear to be large they are in fact modest in proportion to the equipment requiring replacement.

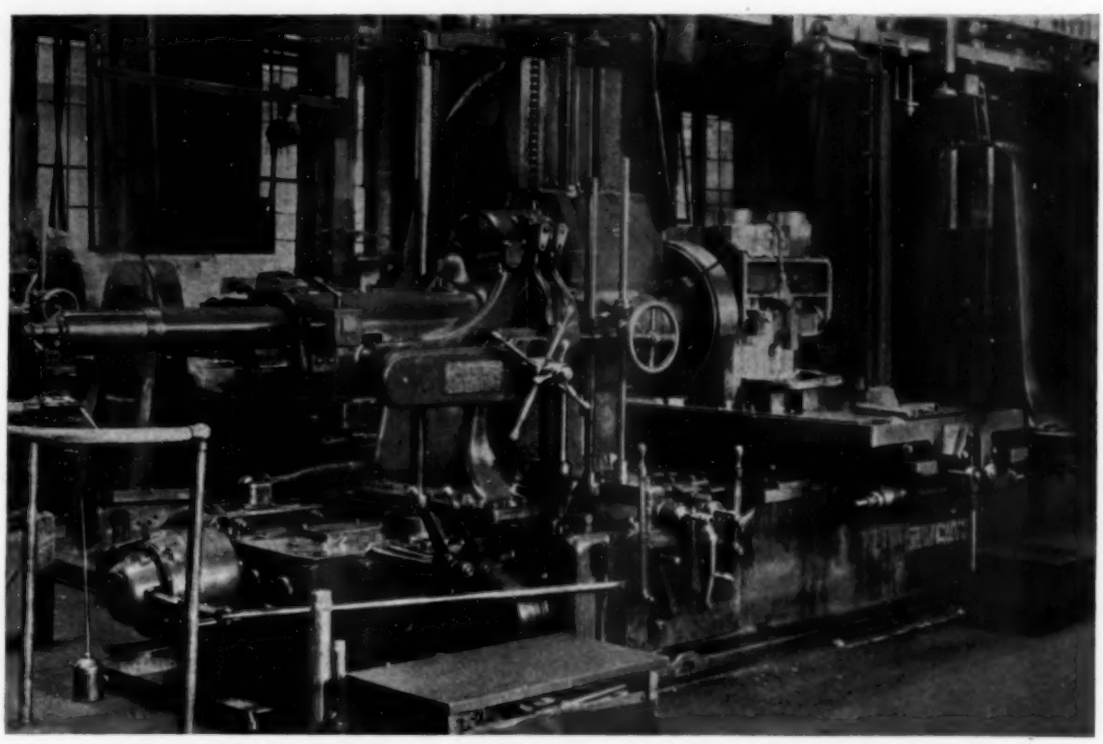
At present the yard's work load is greater than at any time since its wartime peak. With present building activity, where arc welding equipment has replaced riveting, where stainless steels harder to cast, tougher and harder to work have replaced ordinary steels, and higher speed machinery with its demands for closer and closer tolerances is being specified, the gun factory is more in need of new tools than ever.

Peace-Time Purchases

There is one situation which continually confronts those responsible for the proper functioning of the naval construction and repair facilities in time of a national emergency. Good, accurate machine tools require time to have their parts seasoned before machining, time for careful machining, scraping and fitting of parts together and time

for proper inspection of each piece before and after assembly. Cutting of any of these times short results in an inferior product, a product that ultimately will not produce the accurate, fine work which is demanded by the fighting machines of today. The more modern our navy yards are kept, the lower their production costs and the fewer the machine tools that will be required from a market which undoubtedly will be greatly over-taxed by various demands in time of war.

In order to gain the advantage in action the first salvo must land on its mark. After that it's the hits per gun per minute that count. The ordnance equipment on each of our ships must be perfect. Let us then see that our Navy Yards are equipped with machine tools that can turn out a first class job.



Only modern tools like this horizontal boring machine can turn out jobs without excessive and costly handwork. The Gun Factory has plenty of work for such tools

CYLINDER BUSHINGS on the Norfolk & Western

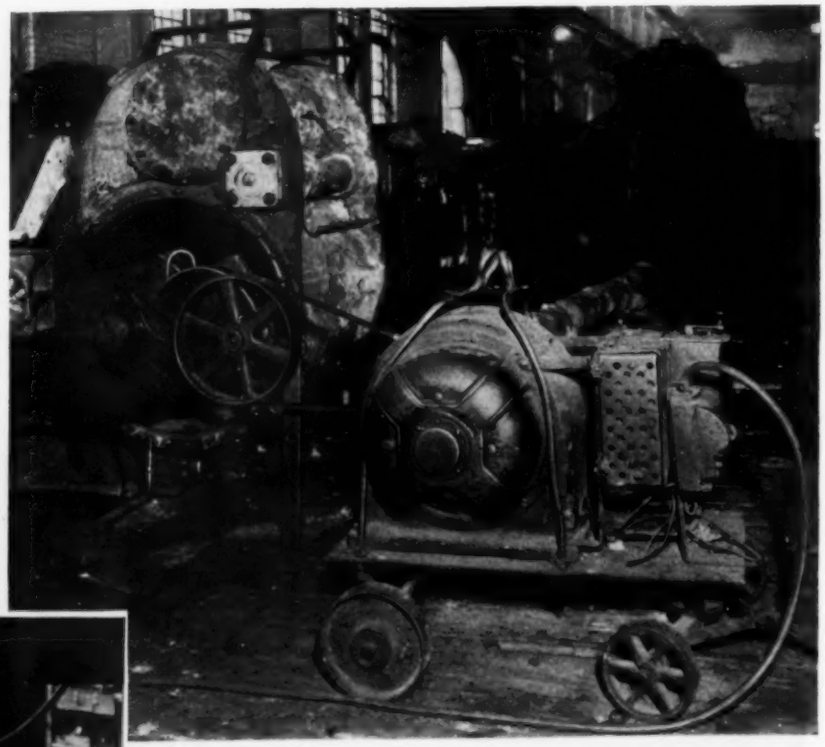
FRED H. COLVIN
Editor, American Machinist

Increased size of locomotive cylinders, especially for compound engines, has required new back shop operations on one road

LOCOMOTIVES, especially on mountainous railroads where coal or heavy freight is a large part of the tonnage, have grown to large proportions. This means large cylinders, especially on the low-pressure side of compound locomotives. And large cylinders introduce problems for the back shop as shown in the accompanying illustrations of the Roanoke shops of the Norfolk & Western railway.

In Fig. 1 the low-pressure cylinder is being bored for a new bushing with the cylinder in place on the frame. The boring bar is driven by the portable electric motor through double reduction gearing plus the speed reduction from the belt between the motor and the drive pulley. The boring bar housing is a combination of cast and sheet metal, the latter being a good example of welding where it guards the gears.

After the bushings are turned and bored, they are drilled under a radial as in Fig. 2. The ports are laid out on the whitened portion by a prick punch. Then the small holes are drilled to outline the portions to be cut out, while the larger holes form auxiliary steam ports behind the full or open port. This method was adopted to prevent the piston rings from dropping into the open ports, as happened occasionally when this part of the port was left open. These holes permit the steam to escape into the cylinder port, the metal between the holes acting as a guide or support for the piston rings.



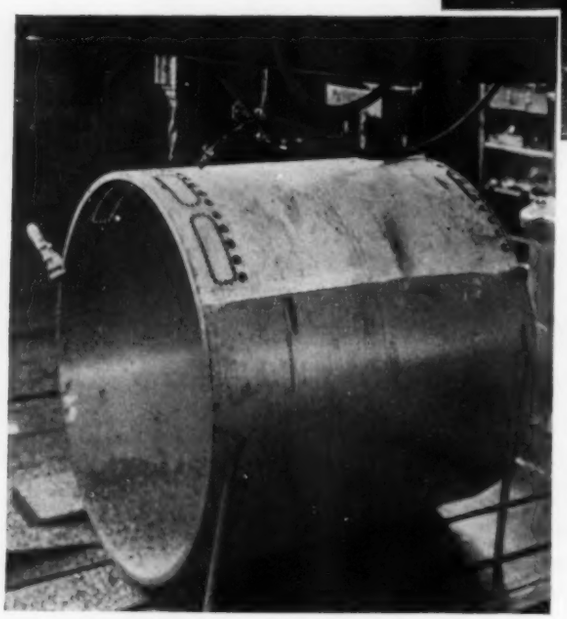


Fig. 1, above—The low-pressure cylinder is bored for a new bushing while it is attached to the engine frame

Fig. 2, left — Trouble caused by piston rings dropping into open ports is eliminated by the use of a line of large holes

The bushing is 39 in. on the inside diameter, 40½ in. on the outside diameter and 39¼ in. long. It rests on the table of the radial and is rolled against the two long bolts in the foreground by means of the screw wrench shown.

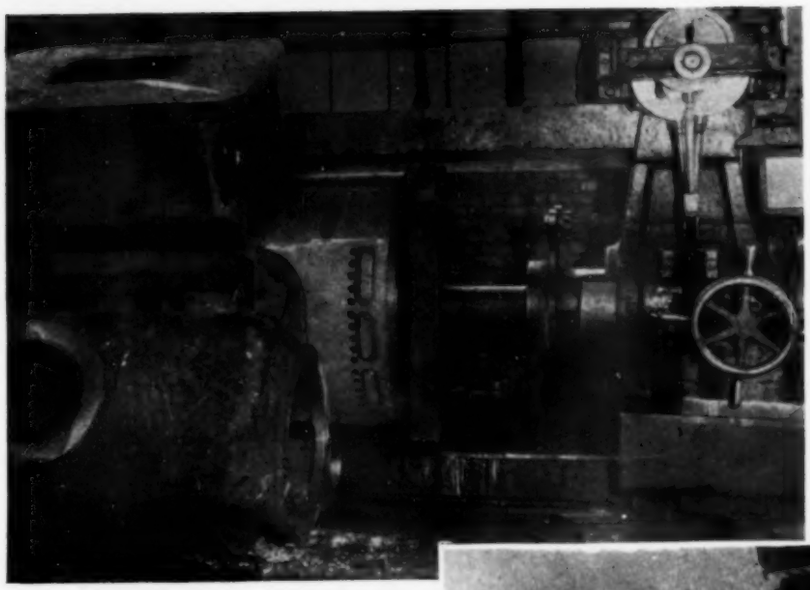


Fig. 3, left—After a groove is chipped through the holes which outline the ports on the bushing, it is forced into the cylinder by means of an hydraulic press

Fig. 4, below—Bushings are installed by means of a screw and nut in the case of cylinders previously in operation. A reversible ratchet permits use in either direction

An air hose makes it easy to keep the chips off the work.

Next, a beveled groove is cut through the small holes which outline the ports. This makes it much easier to cut the pieces out after the bushing has been forced into place. For new locomotives this is done in a hydraulic press, Fig. 3, with a special, long crosspiece suspended at the end of the ram, making contact with both top and bottom of the bushing. This view shows the depth of the chipped grooves around the edges of the ports.

Where cylinders already in use are bushed, the bushing is forced in with a screw and nut as in Fig. 4. The nut is operated by a ratchet in the end of the long, pipe-handled lever shown. The ratchet is reversible so as to be used in either direction.

Chipping is completed after the bushing is in place in the cylinder, as in Fig. 5. First a grooving chisel is used to cut the metal between the drilled holes until it meets the groove on the opposite side and the pieces drop out. Then the edges are trimmed with a flat chisel, as in Fig. 5 and the corners beveled. The bushing is then ready to receive the piston and its rings, after being bolted back on the frame.

Fig. 5, right — A pneumatic hammer is used to cut out and bevel the edges of the ports after the bushing has been pressed into the cylinder

Sprayed Metal and Its Uses

E. J. TANGERMAN
Editorial Staff, Power

Steady development during the past three years has made the metal spray process a practical working tool

Without removing the rotor from this steam turbine housing, the shaft was built up to size; spraying is possible because of the low heat developed in spraying

EVERY machinist apprentice has sought the mythical "putting on" tool; every machinist has needed it at times. At first it seems as if welding would serve, but welding is essentially a process for joining members or building up small areas with a heavy deposit. Then it looked as if the sprayed molten metal process would answer. But coatings were limited to certain metals and had a tendency to "lift" from the surface even by the slight pressure of a finishing tool because of insufficient bonding. Sprayed metal forms no fused bond with the base as welded metal does; it is held entirely by mechanical interlocking of the sprayed edges of the molten particles.

Three years ago the metal-spraying process began to come into its own. Apparatus now offers satisfactory assurance of success if properly applied. Substantial savings are possible over older repair and maintenance methods for certain jobs.

Modern metal-spray guns weigh, with the attached rubber hose, less than 5 lb., are fully self-contained and portable. Metals to be sprayed, such as lead, tin, zinc, aluminum, nickel, silver, copper, brass, bronze, monel, stainless steel, high- or low-carbon steel, are introduced as wire from 20 B&S gage (0.032 in.) to $\frac{3}{16}$ in. in diameter. Guns require three hose connections, oxygen, acetylene and compressed air—oxygen and acetylene to create the melting flame; compressed air to drive the turbine actuating the knurled wire-feeding wheels, to cool the gun and to supply the blast which drives out the molten pellets at speeds of 30,000 to 50,000 ft. per min.

In some instances, hydrogen or city gas is used instead of acetylene, and has the advantage that cost may be less and flame characteristics better in specific applications. The speed is slower than with acetylene. Some guns have special boxes to permit powdered metal to be fed instead of wire. Any metal up to tantalum (melting point 5250 F.) can be sprayed. The time interval from melting to deposit is less than 0.001 sec.

The first essential in successful spraying is a properly prepared surface. Flat surfaces are usually prepared by sand or grit-blasting. This produces a clean surface, roughened with the maximum number of microscopic keys or dovetails necessary for good adhesion. Knurling, scratch brushing, scaling, pickling, etching and anodic electrical treatment are not so satisfactory. Blasted surfaces should be sprayed within 24 hours after preparation to insure cleanliness and avoid oxidation, as surface accumulations of grease, oil or moisture cause defective work. If prepared surfaces must be handled, the operator should wear gloves.

If sand is used for blasting, it should be 16 or 20 mesh with angular grains; steel should be No. 40 if used on surfaces to be sprayed with the softer, lower melting-point metals or No. 30 for higher melting-point metals. Rates of blasting are about 100 sq.ft. per hr., for sand, 80 for No. 40 grit, 50 for No. 30 grit. Standard blasting units may be used, with air pressures of 40 to 80 lb. gage, rated capacities 750 to 1,000 lb. of sand, with the nozzle $\frac{1}{4}$ in. in diameter delivering about 75 cu.ft. per min. of air.

If air is supplied from a separate compressor, it should have 105 cu.ft. per min. actual delivery at 80 lb., thus supplying both blaster and spray gun simultaneously. The branch connection to the gun should have an air filter rated not less than 35 cu.ft. per min. for completely removing oil, water and dust particles.

Pieces to be coated, which are cylindrical in cross-section, such as shafts, piston rods, crankshafts, pistons, and plungers, are handled somewhat differently. Such pieces are best both prepared and sprayed in a lathe. Worn,

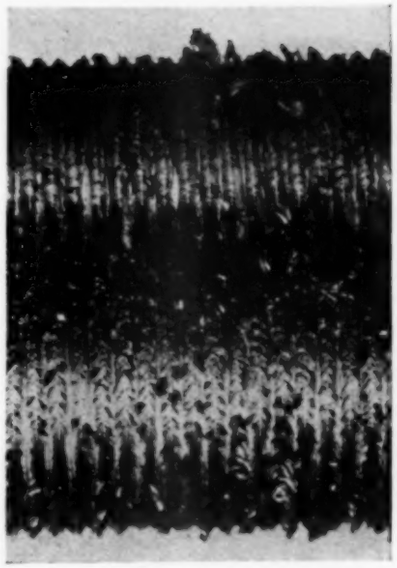
corroded, scored or undersized steel shafts are first prepared by taking a lathe cut the full length of the section to be built up. The depth of cut depends upon piece and service conditions; on an inner ball race, a few thousandths is enough; on a shaft, recommended practice is to take off $\frac{1}{32}$ in. per in. of shaft diameter. The ends of the cut are undercut slightly. Then with a V-point tool the entire section to be coated is threaded, using pitch of 30 to 32 threads per in. for 1 to 4-in. shafts, and 24 per in. for shafts larger than 4 in. This should be done dry, to get a rough surface; in fact tool chatter is all to the good. Then a square tool is run over the work just clear of the thread tops to pick off burrs. Surfaces should be kept free from oil, grease or grit, and spraying should be done at once. A cylindrical surface so prepared gives bonds twice as good as those made on a grit-blasted surface.

In coating, the spray gun is set on the lathe toolpost and fed at $\frac{1}{32}$ to $\frac{1}{8}$ in. per revolution, with the surface speed of the piece selected to give coverage of about 40 sq.ft. per min. This assures complete overlap of the edges of the deposited ribbon, and as subsequent coats are applied the surface will smooth out. If the surface is short, it should be allowed to cool after every two or three runs of the gun, and the temperature should be checked regularly to avoid overheating. A simple check may be made by laying the back of the hand on the piece. If the surface is not too hot the hand can be left on for at least three seconds comfortably.

An Alternate Method

On refrigeration compressor crankshafts, an alternative method has been used successfully. Instead of threading or grooving, the surface to be coated is undercut 0.040 in. in diameter, then knurled, lightly sand blasted, and built up to 0.020 in. oversize with 18-8 stainless steel. This gives a surface, when machined, resistant to corrosion and abrasion from packing.

Bronze pump rods or plungers, subject to temperature variations or corrosives, can be built up with stainless steel, providing the facing does not extend out to the ends. If the coating goes all the way to the end, there is danger of corrosion through the penetration of liquids under the coating and from a difference in coefficients of expansion. If essential to run the coating to the ends, the rod should be undercut, but better still, bronze should be welded on for $\frac{3}{4}$ in. at the ends, then undercut at the inner edge to serve as a dovetail for the coating.



A rough thread forms an effective bonding surface on shafting; burrs are removed before spraying with a square nosed tool

Under reasonable temperature variations, the strength of the bond is sufficiently great to overcome any temperature stresses set up because of unequal rates of expansion.

Another thing to watch when using sprayed metal is electrolysis, caused by battery action between a base metal and a dissimilar coating. The need is to get metals "anodic" or protective to the base. Zinc, aluminum and cadmium are anodic to iron and thus protect it best. Tin or copper coats accelerate corrosion if they are thin enough to let moisture penetrate through to the base. Lead and tin, extremely valuable in resisting corrosion from most commercial acids, must be applied heavily or they only make matters worse. Brass, bronze, monel, nickel and nickel-silver all accelerate the corrosion of iron, but often are the best materials to combat a specific set of conditions. The answer is thick coatings, proper bonding, and proper combination of coatings. Aside from this, zinc, aluminum and lead have the desirable characteristics of corroding only until a protective coating of salts is formed on the surface, when they prevent further corrosion of themselves or the base metal.

With standard spray nozzles held perpendicular to the surface and 5 in. from it, the molten spray covers a circle about 2 in. in diameter. The best working distance and size of impact circle, of course, vary according to melting temperature and physical properties of the metal sprayed, about as follows:

Steel, 4-6 in. distance. Circle $\frac{1}{2}$-$\frac{3}{4}$ in. diameter.

Zinc, 6-8 in. distance. Circle 1-1$\frac{3}{4}$ in. diameter.

Lead, 8-10 in. distance. Circle 1$\frac{1}{4}$-2 in. diameter.

When metals that have a toxic effect, such as lead and cadmium, are sprayed, the operator must wear a mask or helmet. No goggles are necessary for protection against the light of the flame, and the spray cools so rapidly that the bare hand may be passed through it two feet from the nozzle without burning. Special cabinets, to prevent operators from inhaling metal dust and fumes, are now available and are suitable for use when fairly small pieces are being coated. Compressed air jets form a screen across the front of the cabinet, and waste metal and fumes are sucked by a fan down through a series of steel grids that form the working surface.

The best deposits are produced when the axis of the spray is at right angles to the surface being coated, although satisfactory coating has been done at angles down to as much as 45 deg. Surfaces have even been coated at angles down to 20 deg. where it was impossible to get the gun in, but apparently aiding in these cases was ricochet from an interfering surface.

Wire Feed Rate

Rate of feeding wire into the gun should be the lowest consistent with economy and fine atomization, for it penetrates and bonds better. Heavy-duty guns spraying at high rates are, however, being used successfully in coating steel surfaces with steel where thickness of coating and economy are more important than bonding and imperviousness of coating.

Work should always be done at or slightly above atmospheric temperature to avoid condensation of moisture, which damages the bond.

Gas pressures at the gun run from 13 to 15 lb. gage, and air pressures 45 to 75 lb., depending upon metal and type of application; hourly consumptions for the standard guns from 23 to 26 ft. of oxygen, 22 to 25 cu.ft. of acetylene, and 2,500 to 3,500 cu.ft. of compressed air. Metals with high melting temperatures require small

Photo Courtesy Metallizing Company

Two guns spraying simultaneously applied 28 lb. of 0.0625 in. steel wire as a steel insert ring on this cable drum. After spraying two hours, the job was allowed to cool an hour before completion

wire fed at low speeds, those with low melting points permit larger diameters and higher feeding speeds. The range is 10 to 34 ft. per min., corresponding to feeds of from 1.25 to 4 lb. per hour for iron and 25 to 80 lb. per hour for lead. The area covered varies from 6 to 12 sq.ft. per hour, for iron, to 60-120 for lead, with coatings in each case 0.006 in. thick. Larger guns increase these rates somewhat but are suitable only for coating large areas.

Special nozzles cut down the rate of deposit but are essential in hard-to-get-at places. These include fan nozzles throwing a spray 3/8 in. thick and 1½ in. wide, and angle nozzles set at 45 deg. from the gun axis. Rotating nozzles for coating interior surfaces have extensions of 30 in. to 12 ft. to pass inside 1 to 4 in. inside diameters and extensions up to 30 ft. for coating inside diameters above 4 in.

Thickness of metal deposited per pass of the gun varies with the metal sprayed and speed of pass. Average thicknesses per pass are:

0.003 in. for cadmium, lead, tin and other soft metals.

0.002 in. for zinc.

0.0015 in. for bronze, copper and other metals melting from 1,000 to 2,000 F.

0.001 in. for monel and stainless steel.

Required thicknesses are built up by making successive passes. Usually coatings are built up 0.040 in. oversize to allow for machining or 0.020 for grinding, if finishing is required. Maximum practical thicknesses of coating on ordinary work are about 0.200 in. for shafts and 0.050 for flat work.

Any ordinary machining process may be used for finishing sprayed coatings, including turning, milling, filing and buffing, although finish by grinding is both more economical of metal and less likely to "lift" the coating. Sprayed metal reacts somewhat as cast metal does to machining. A round-nosed tool taking fine cuts should be used in finishing soft coatings, a pointed tool for harder ones. The rate of feed and speed of cutting should be controlled to avoid overheating. A heavy coat properly bonded to a shaft or surface may be cut right through for its full length—as for a keyway—without danger of lifting the coating.

The choice of grinding wheel is important if the sprayed metal is steel. Carborundum Aloxite, 401 grit, grade L, bond 29, has been used successfully and is suitable for most grades of ferrous metal, but not for brass, copper, tin or aluminum. The Norton Company, in a series of extensive tests, has selected the following wheels as best for specific materials: stainless steel, 3846—K5B Crystolon; high-chrome stainless, 3746—M Crystolon; high- or low-carbon steel, 46—J5B Alundum. All grinding should be done wet, with wheel speeds of 6,000 s.f.p.m. and a coolant composed of 1 part soluble oil to 40 parts water.

Bond Strengths

Sprayed metal coatings may have mechanical bonds as high as 500 lb. per sq.in.; suitable heat-treatment will raise this figure to 1,600 lb. per sq.in. Sprayed metal the same as the base may give better wear in a bearing because the oil penetrates the permeable structure and impregnates the coating, just as it does in the so-called "oilless" bearing.

The density of sprayed coatings is about 10 per cent less than that of cast metal, because of this peculiar structure. This may be compensated for by putting on heavier coatings, applying a top coat of a harder metal (e.g. bronze or monel) over a heavier undercoat of soft metal (e.g. zinc or lead) which is less likely to be porous, working the metal mechanically by wire-brushing, grinding or polishing, or by applying some chemical solution to fill the pores. It is inadvisable to spray pieces to be fabricated afterward by bending, rolling or drawing.

The hardness of any wire material is increased about 55 per cent when it is sprayed; thus high-carbon steel of 270 Brinell in the wire will show 400 after being sprayed.

In addition to its earliest use for corrosion resistance the process is now being used for heat and fire resistance, electrical conduction, building up worn, undersized or underweight parts, and for decorative effects. To prevent corrosion, zinc and aluminum are now usually used at least 0.005 in. thick for service in air, 0.010 to combat corrosion submerged, the aluminum pref-

erably a little heavier. Lead coats may be anywhere from 0.015 to $\frac{1}{8}$ in. thick, or heavier to combat stronger corrosives or give longer service. Bronze, monel, and the steels are not impervious when sprayed alone unless the coating is 0.020 in. thick or thicker. It may be cheaper to apply them over or under a thick coat of softer metal. The hard metal then gives abrasion resistance, the soft metal fills the pinholes.

"Alumetizing"

Heat corrosion has been a difficult problem until recently. Now aluminum is applied 0.005 to 0.010 in. thick for this service. Zinc may also be sprayed over galvanized pipe joints. A new process, "Alumetizing," is being used on parts subject to high temperatures and flame impingement. The piece is sprayed with aluminum, then receives three coats (dip or brush) of potassium silicate, heated to 1,400 F. for 5 min., raised to 1,900 F. and allowed to soak for a time depending upon the size and bulk of the piece. This produces a deep ferro-aluminum alloy with an aluminum oxide surface. The dried potassium silicate is simply brushed off.

Harder metals are used to combat abrasion, either alone or as the top coat over a softer metal. The cost runs 5 to 50 per cent of replacement, wear is as good as the original, sometimes better (particularly on shafts).

Surface defects in castings and forgings are now being built up by the process, particularly those sand-holes or blow-holes discovered after considerable money has been spent in machining a piece. The hole is chiseled out as a patch not more than $\frac{1}{8}$ in. deep, then dovetailed all around the edges at a 45-deg. angle. Edges are kept clean and sharply defined to avoid ragged edges after machining. If the patch is bigger than $2\frac{1}{4}$ in. in diameter, small pins should be set at angles in the center of the filled section or a small countersunk head should be set below the surface. The edges outside the patch are then masked with rubber masking tape, the patch blasted with steel grit thoroughly, and low-carbon steel is sprayed in, beginning at the edges and working toward the center. Care should be taken to avoid overheating the metal. Usually, the patch should be built up $\frac{1}{32}$ in. above the base, then machined down. Such a patch will withstand temperatures up to 1,600 F. and is practically invisible.

The process is also being used for rebabbitting bearings, since it avoids tinning the shells, gives a stronger bond, avoids lifting and cracking, porosity and blowholes. Suitable wire is now available in either "government genuine" or "diesel marine" grades. For heavy-duty service bronze bearing liners can be given a thin coating of babbitt to reduce the tendency to overheat. The choice between recasting and spraying generally depends on thickness; about $\frac{1}{32}$ in. it is usually cheaper to cast. Worn babbitt liners should not be refaced, because the remaining base metal has probably deteriorated from fatigue.

Small pieces such as bolts, nuts and washers may be coated in bulk by placing them in 100-lb. lots in a special tumbling barrel. The gun is then directed at the pieces while the barrel is rotated. Coating applied is usually so thin that threads will not have to be cleaned up. This also avoids the edge loss which always wastes metal when small pieces or thin edges are sprayed.

With $\frac{1}{8}$-in. rod applied at 6 lb. per hr., the total cost including metal, gas and labor will run 50 cents per lb. for cheaper steels, $1 a lb. for monel and stainless steel. With a 0.006-in. coating, the material cost, per sq.ft. is: iron, 18 cents; lead or zinc, 11 cents; aluminum, 9 cents. Sandblast or grit-blast can be estimated at 3 cents to 5 cents per sq.ft. Of course, all sorts of variables enter, such as variation of set-up time, edge loss and difficulty of reaching surfaces.

One company gives this table:

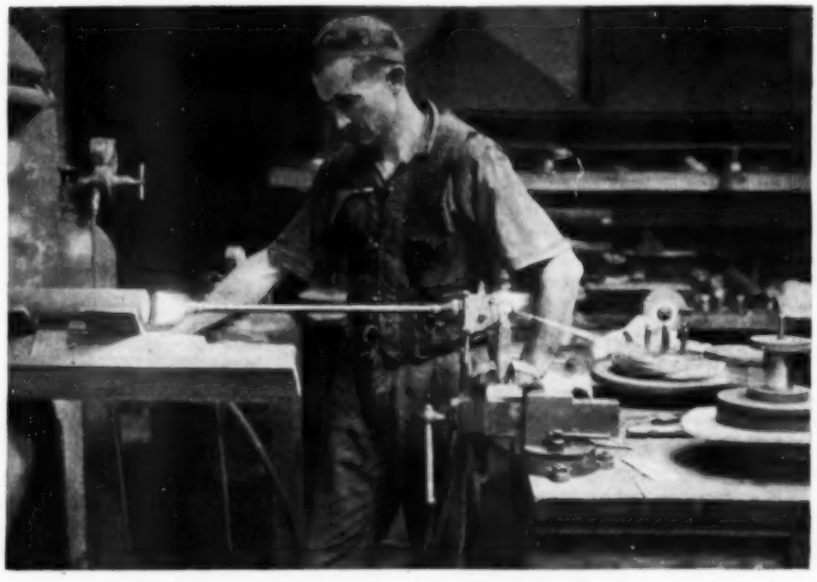
Sprayed metal	Cost per lb. in cents	Thickness for 1 lb. of metal per sq.ft of surface, in.
Bronze	40	0.023
Lead	25–28	0.010
Steel	50	0.022–0.024
Tin	4	0.014
Zinc	12	0.015–0.017

These figures include gas and labor, but not metal, sandblasting or finishing. Unit costs are based on:

Item	Unit Cost	Per Hour Amount	Per Hour Cost
Acetylene	$2.40–$3.60 per 100 cu.ft., average $2.75	24 cu.ft.	$0.66
Air		2,500 cu.ft.	0.20
Oxygen	$1 to $1.85 per 100 cu.ft., average $1.20	25 cu.ft.	0.30
Labor	$0.60 per hr., 70% time efficiency	1 hr.	0.86
			$2.12

Standard spray guns with all attachments and all accessories needed for the usual production, repair and maintenance work, cost about $530 f.o.b. factory. Sand-blasting units run about $195, a safety blasting helmet $27, grit about $90 a ton, sand $3.50 to $10 a ton.

Three companies in the United States manufacture the spraying equipment, Metallizing Company of America, Inc., Metals Coating Company of America, and the Metal Spray Company. Material for this article was received from all these sources, from several independent users of this equipment, and from published papers, including several recent ones by the Air Reduction Sales Company, sales agent for Metals Coating Company. Data has been checked by R. A. Axline, Eastern manager, Metallizing Co.



A spray gun with a rotating extension nozzle coats the interior of a small pipe. By combining wires from several spools a copper alloy is applied to the bore

How to Survive During Inflation

JOHN HAYDOCK
Managing Editor, American Machinist

Manufacturers of capital goods must protect themselves against rising wages and material costs if their working capital is to be preserved

MANY of the statements made about inflation are confusing because they fail to include a clear definition of the word "inflation" itself. Are we going to have inflation or are we not, are questions heard almost daily. If we define the term as a partial destruction of the value of currency, inflation is already here.

The United States no longer has a free market for gold; the Supreme Court has ruled against gold clauses in private contracts and has declared those in federal bonds valid but inoperative. We have a rapidly increasing federal deficit, always a basic cause of inflation; our currency has already been devalued 40 per cent in terms of its gold content which is, in percentage, half the loss of the value of the franc at the time of stabilization.

Misunderstood Conditions

These conditions are so new in this country that they are commonly misunderstood. In 1933, when we first went off gold, many expected that we would immediately be plunged into inflation of the German variety with a rapid flight from the dollar. Historical evidence shows us that inflation is a slow phenomenon; it is only the final manifestations that are sudden and drastic. The period of inflation in France was twelve years; in Germany nine with the after effects lasting several years more.

Of the many phases of this complex subject only one will be discussed here. What can the manufacturing executive do to protect his business against the ravages of inflation? For inflation is a destructive force, as can be proved by past experience. Even groups, such as the farmers, whose spokesmen are active in promoting dilution of our currency, will be sorely injured. Inflation tends to destroy the middle class, that large group of small business men and wage earners with moderate savings and modest investments. In this group belong the great mass of life insurance holders, savings bank depositors and beneficiaries of small legacies and annuities. They form the backbone and balance-wheel of any social system. Their destruction as a class always entails the hazard of far-reaching economic chaos.

One important concern of the manufacturer is the preservation of his working capital. During periods of currency depreciation and rising prices it is essential that working capital be expanded in like proportion. Failure to do this means depletion of reserves and, if continued, bankruptcy.

One popular conception of inflation is that while savings, endowments and other sources of fixed income suffer as prices rise, companies actively engaged in manufacture or trade are benefited by the stimulation of spending. This is a misconception which may be refuted by the records of business failures in countries that have been through this experience. In France average monthly failures of incorporated companies in 1918 numbered 19; in 1919, the average was 59. During the years that followed, France's monthly average of failures was:

1920 — 115	1926 — 628
1921 — 255	1927 — 689
1922 — 420	1928 — 684
1923 — 451	1929 — 726
1924 — 569	1930 — 756
1925 — 659	

Thus bankruptcies rise sharply in the period of inflation and continue during stabilization and the period of deflation which necessarily accompanies it. France's present struggle to retain the current gold basis of the franc is a reflection of the bitter memories of distress that resulted from the loss of confidence in its currency during 1922-1926 and the difficult years in restoring a stable standard that followed. In Germany the mark changed so rapidly in value that many companies went bankrupt without knowing it. Restoration of a fixed currency, first in Rentenmark and then in Reichsmark, gave the nation a yardstick which disclosed a long record of insolvency. In most cases the cause was dissipation of working capital, making it impossible to carry on the business without new financing.

Preservation of Assets

In the capital goods industries, it is particularly important that close consideration be given to preservation of assets. Many kinds of machinery are not delivered from stock but are built specially, in part or completely, for a particular customer. This necessitates a time lag between signing the order and delivery of the machine. There may be an additional interval under the terms of the contract before final payment.

The total period may extend from several months to over a year. In a period of rapidly rising prices, the seller may be seriously injured if he has not guarded against such a contingency. Let us assume that, during the period between his outlays for labor and material and final payment, prices have doubled. If the sale was made on the basis of current costs, at the time of signing the contract, the seller will find that when he receives payment he can buy only half as much labor and material for future business. In short, his working capital has been halved.

In process industries it is often possible, by contracts for future delivery or by building up of inventories, to hedge against rising material prices. Such protection is strictly limited in its application to machinery manufacturers. There is no way of hedging against rising labor costs.

Records in France and Germany show that companies resorted exten-

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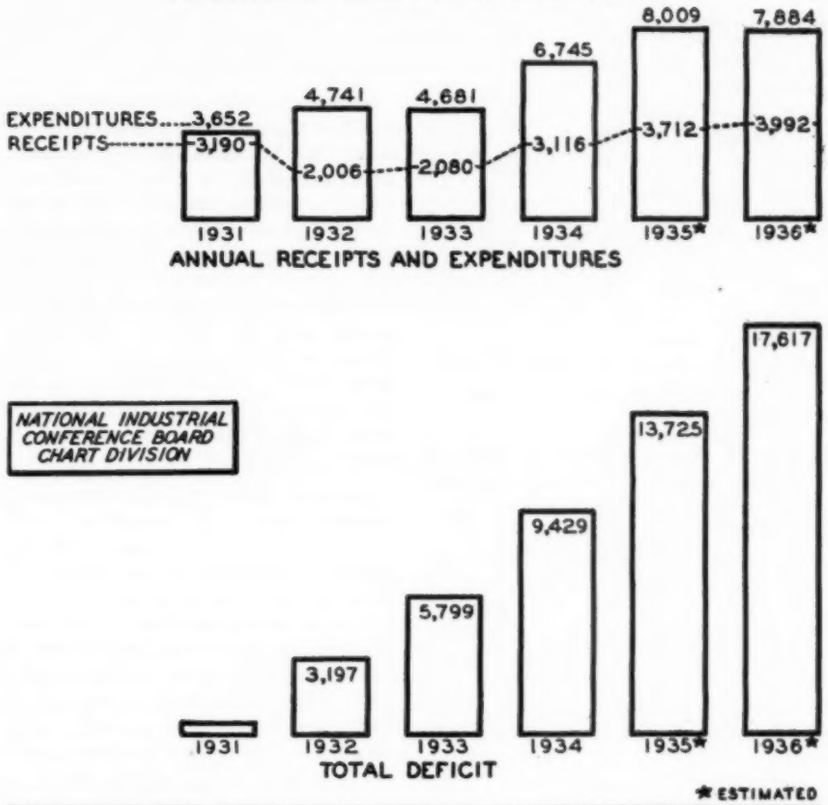
Many of the facts upon which this article is based were supplied by Dr. Walter S. Landis, vice-president, The American Cyanamid Company.



Data for expenditures, receipts, and deficits are for general and special fund accounts; public-debt retirements are not included in expenditures. Trust funds and other miscellaneous items separately grouped by the Treasury are excluded. All data for completed fiscal years are on the basis of daily treasury statements, unrevised.

sively to borrowing in order to augment their declining working resources. Experience here dispels another popular illusion concerning inflation—that business enterprises profit through the drastic reduction of their fixed indebtedness when currency is devalued. The record shows that the opposite is true; that almost without exception the fixed indebtedness of industrial enterprises increased rapidly, often at a greater rate than the volume of business. When stabilization finally arrived, these concerns carried a staggering burden of overhead, usually without any increase in volume of business.

But borrowing to maintain working capital can proceed only so far. Investors soon discover that it is decidedly unprofitable to put out currency and have it returned when its buying power has been greatly reduced. Interest rates rise first slowly and then soar skyward with accelerated speed. In September 1923 the official bank discount rate of the German mark was 900 per cent, which was considerably under the actual basis of industrial loans. Borrowing for industrial purposes may become out of the question.

The manufacturer may resort to two ways for preserving his working capital. He may increase prices in anticipation of rising costs or he may put clauses in his contracts providing a degree of flexibility to prevent large losses. His ability to step up his prices is usually limited by competition. No matter how carefully his policy is planned, he cannot advance prices if his less well informed competitor persists in offering goods at the old level. Such competition may not be caused by chiseling or bad faith; more frequently it is the result of ignorance. In such cases the farseeing executive may perform a real service to his industry by giving publicity to his views of the situation and the steps that are needed to avoid financial failure.

Since the Supreme Court declared that gold clauses in private contracts are invalid, this means no longer affords protection. Contracts may be written which enable the seller, under certain conditions, to advance the original price in accordance with currency value at the time of payment.

Many methods of doing this have been devised and used. One is to base payment on exchange in terms of a foreign currency. For instance, a contract in the United States could be written to provide payment in the dollar equivalent of a certain number of Swiss francs.

Basis for Contracts

This means was widely resorted to in European countries during periods of depreciating currency. At first, business men hesitate to use this method because of their faith in their own country, its government and the integrity of its currency. This attitude persists even when actual devaluation has progressed a long way. When the mark fell to five per cent of its prewar value only a few business men appreciated the future evils. It usually takes the bitter experience of large losses before a foreign currency will be used as a basis for contracts. However, it is an effective means for hedging against devaluation if a stable basis of comparison can be found. The difficulty is that, with gold markets closed or restricted, there may be periods without a good basis for exchange values; or the country which the contract specifies as a basis may also devalue its currency. Export sales, of course, may specify payment in the currency of the destination, if that seems advisable.

Commodity prices have also been widely used as a method for fixing future payments. Here again difficulty may be experienced. Commodity prices may lag several months behind exchange rates even when both are changing rapidly. There is also the problem of securing a good index, as agricultural products and metals, for example, may vary considerably in their rate of advance.

In writing protective clauses into contracts, competition must again be

considered. It is difficult to sell the idea of these clauses to customers when another supplier does business without them and offers his goods at a flat price.

Still another difficulty comes from the fact that clauses which provide a conditional price increase usually permit the buyer to cancel the order if he does not agree to the new figure. The purchaser refuses to write a blank check in the form of a contract that binds him to pay an undetermined sum at some future date. The cancellation clause may work out without causing trouble in the sale of a commodity but may prove unsatisfactory to the machinery builder. If the sale covers equipment that is entirely special or specially adapted to meet the customer's needs, the manufacturer cannot permit the contract to be cancelled without redress.

Since we have already experienced a degree of inflation, we cannot now escape all its injurious aftermaths. We can, however, make every effort to keep it within bounds so as to minimize the distress that it will cause for every element of our population.

In the final analysis the only way of curbing the present trend toward further inflation is to bring government expenditures into balance with receipts. Since expenditures are appropriated by Congress, pressure must be brought to bear on representatives and senators to curtail federal outlays within the limits of revenue received in taxes.

Industries directly benefitting by large governmental orders may suffer temporarily, but the return of confidence which will accompany a determination to restore a balanced budget will release a flood of private investment that should exert a potent influence in stimulating business. Until a balanced federal budget is assured, manufacturers for self-protection must carefully watch their prices.

Calculating Tap-Drill Sizes

Typographical errors appeared in the article by William S. Rowell (*AM*—Vol. 79, page 302). The last sentence on that page should have read:

"My rule is to divide the double depth of threads of 1-in. pitch by the pitch of the threads on the tap to be used and subtract the quotient from the diameter of the tap. Thus for a ½-in. tap having 13 threads per in. the figures would be $\frac{1.3}{13} = 0.100$ in."

Some Practical Notes on Soldering Aluminum

A. EYLES
St. Albans, Hertfordshire, England

Although aluminum is one of the most difficult metals to solder, the task is comparatively easy if a few simple rules are followed. It is well known in soldering technique that all forms of soldering require the application of the correct amount of heat to obtain a first-class joint, and that the temperature required varies with different metals, irrespective of the solder used. In many cases failure in soldering aluminum and aluminum alloy products can be traced to incorrect regulation of the heat used in making the joint.

In fact it is a mistake to think of soldering aluminum as being the same process as that in soldering tin plate and brass with a hot copper bit and a solder that will flow and follow the soldering tool speedily. Aluminum is not soldered that way, the technique being more like brazing with hard solder. When this fact becomes established in the mind of a skilled mechanic, he will have no difficulty in soldering aluminum and its alloys, providing he has the right kind of solder and efficient equipment.

Tinning the surfaces to be joined preparatory to actual soldering is an important operation. The process of tinning is accomplished by heating the surfaces to be soldered with either an atmospheric gas torch or with a kerosene blow torch to a temperature slightly above the fusing point of the solder and then scraping the surface with a clean, steel scraper to remove the oxide film and permit the solder to act upon the clean surface. The higher the temperature, within certain limits, at which the tinning is done the better will be the adhesion of the tinned layer. After the surfaces to be joined have been properly tinned, they are united by pressing them together and again heating the parts to the required temperature.

In regard to the composition of aluminum solders, those that the writer has found to be most satisfactory are composed of tin, 75 to 90 per cent; zinc, 18 to 25 per cent; aluminum, 5 to 15 per cent. A typical composition is tin, 82 per cent; zinc, 10 per cent; aluminum, 8 per cent. Most aluminum solders are best applied without a flux after preliminary cleaning and tinning the surfaces to be soldered. Indeed many fluxes are a hindrance to progress. Zinc chloride, the most commonly used soldering flux for other metals, should not be used in soldering aluminum or its alloys, as a certain amount of zinc is reduced from the flux at soldering temperature and alloys with the aluminum.

Soldering cracks or fractures in automobile components of aluminum or its alloys, such as oil sumps, or gear cases, which are usually in a very greasy condition, is perhaps the most difficult job the average mechanic encounters, especially if the surfaces are so located that they cannot be properly cleaned by scraping or filing. Grease must be removed from the defective part before it can be tinned, and a good way of doing this is to first burn off the oil and then to vigorously brush the surfaces to be joined with a steel wire brush.

Soldered joints in large aluminum castings should be reinforced with tinned-iron plates. In many soldering jobs it is advisable to use fixtures to keep the parts firmly in position during the soldering operation. Care must be taken not to remove the fixtures or clamps until the solder has completely set, otherwise the slightest movement while the solder is in a mushy state may result in a partly fractured joint.

In conclusion it may be well to mention that soldering methods should not be employed on stressed aluminum members, nor on parts the failure of which might endanger life. However, there is a considerable field for the application of methodical repair work.

Some Hints From an Old Timer

CHARLES WESLOW

In the last place I was employed, a metal toy factory, we had a foreman of the repair tool room, who showed me a thick 6-in. scale that he got caught in the cutter of a milling machine, which gouged out a hunk from near one end of it. "And do you know," he said, "this scale is the handiest tool I have. I use it pokin' around a die in the press, and lots of other places, and yet it's a scale." All the space that foreman has at his bench is about 10 in. in area, the rest contains all kinds of toy parts, in the process of manufacture or as reference parts. Where else could he stack them? The foreman of the new work has space only for his snuff box. They clean up now and then, but it isn't long before it becomes a mess again,

due to the many parts in metal toys, that they must refer to so often.

I find that carriage bolts are the best kind to use in strapping work to the lathe or milling machine table. I own my own, in various sizes and lengths, and also certain ½ × 1½ × 3½-in. straps made of cold rolled. Thus I save a lot of time looking around the toolroom for such items. And what is so disgusting to a toolmaker as looking for bolts, straps, nuts, and washers, and scrap pieces for packing up under straps? In all my experience, whenever I landed into a new job, I had enough tools besides bolts and straps, so that when I was given the first job to do, I went at it in jig time, to show the boss that I had speed. It's always the first job you do that counts. Do the first job quickly, and after that you can take it easy.

I met a lot of toolmakers who bragged about getting along with the few tools they possessed, but they were forever borrowing from their shop mates. After all, a lot of foremen are unappreciative of the toolmakers with plenty of tools to work with. Some foremen just don't like some toolmakers, and that's all there is to it, no matter how efficient the toolmaker is in his work.

I was born in a cold month, and in all the 210 toolrooms in which I have been employed, I found that I always got along good with other toolmakers who were born in cold months, and found such mechanics most efficient. Therefore, I warn any boy born in a warm month, to stay away from the toolmaking trade. I questioned many apprentices about the month they were born in, and found the warm month fellows disinterested in the trade, and not interested in mechanical work of any nature.

Apprenticeship—Real or Imitation

A. W. FORBES
Forbes & Myers

IN ANY regulation of apprenticeship it is of first importance to recognize the difference between true high-grade programs and inferior imitations. It is the purpose of this paper to point out some of the differences and some of the signs by which they may be recognized. But first I will illustrate by two hypothetical cases.

True Apprenticeship

An employer of 35 men manufactures egg beaters and a few similar articles on a mass production basis. He employs low grade machine operators and routine workers under a superintendent who is an excellent all around mechanic as well as a manager, but when anything goes wrong with the machinery or equipment it is necessary for the busy superintendent to leave his other work so as to direct the task of getting the machinery into operation again.

It is difficult to find a suitable mechanic for this work and, therefore, the superintendent decides to engage an apprentice, a young boy who will start with the care of the equipment and learn the various tasks until he is able to take entire charge of the maintainance and repair. If his ambitions go beyond maintainance there will be a chance later to join in working out improved methods and processes. This plant has a busy season of six months when the employer insists that the apprentice must be on hand at all times when the plant is in operation, ready for any emergency, and that he must also spend an occasional period outside of regular working hours for repairs that cannot be done while the plant is in operation. However, in the other six months, when there is but little to do, he is willing to give the apprentice all the time off that he wants. He will give a two or three months' vacation if he wants, or all the time he desires for school. In the school he will not tolerate instruction about the job, for he thinks he knows so much more than any school instructor about it that any school instruction would be merely interference. Aside from that he is glad to have the boy study anything that he wants.

Imitation Apprenticeship

In a somewhat larger company, making a similar line of goods, in place of the superintendent with more than he can do, we find the work divided among a staff of men each experienced in his particular field. These men are not as efficient as the manager desires, but the work is done fairly well. They are confident of their knowledge, experience and quality of their work, but realize that their positions are not entirely secure. Feeling that their work is not appreciated, they fear that they will be replaced by cheaper men if any are found. They are not sympathetic toward training boys for responsibility. True apprenticeship is impossible.

On the other hand, the manager and all subordinates are trying to reduce their costs by means of cheap labor. They do not find an adequate supply of competent operators at the company rate of 40 cents per hour, so they resort to imitation apprenticeship to meet their need. A formal program is adopted. Two years of training in a trade or vocational school is required before entrance. That has been found to be enough to prepare boys for the semi-skilled work of the operators, enough so that the boys can be put onto regular operators' jobs with but a few hours' practice. Maturity is also demanded of the beginners, for the older boys are steadier workers on routine jobs. It is found that enough apprentices can be secured who are 18 years of age, so this is fixed as the minimum age. In fact, there are thousands of young men available since the depression.

Indifferent Foremen

In order to convince the boys that it is real apprenticeship, and also to convince any other interested parties, the program is planned to give the boys practice in every important task in the regular production. But as each job is under a foreman who has no desire to see the boys get ahead, and possibly get his job, the part of the boy in each of these jobs is merely that of semi-skilled operator. The manager recognizes that in order to keep the boy

content on his program he must give the boy some instruction in addition to what the foremen are giving. Consequently he arranges for the boys to go into a class at the local trade school, where they may learn to do his work at public expense.

When the boy completes his course he is an experienced routine operator, prepared to compete for any 40-cent per hour job in that particular plant. But his training is not such as to lead to higher positions or to help in securing work in other plants. The object has been accomplished. Cheap labor was obtained from the apprentice during his course, and on its completion there is one more applicant to prevent the necessity of raising the wages of the regular workers.

I do not want to suggest that all, or even a large part, of apprentice programs will fall in either of the groups illustrated by these cases. The larger number will be a mixture of these two extremes, or will contain additional features. But an examination of these two plans will bring out certain features that may be looked upon with favor or with suspicion.

Preliminary Training

The first suspicious feature is the requirement of preliminary vocational training. Wherever we see this requirement it suggests that the employer may be trying to exploit the existing knowledge and training of the boy rather than to give the training. As long as the training is not enough so that the boy can secure work and wages of an experienced man, the more he has the better for the exploiter in imitation apprenticeship.

The next feature that should cause suspicion is the age limit, and for somewhat similar reasons. The employer who intends to give a first class all around apprentice program more often desires boys in their more formative years when they can be instructed more easily, and he desires them at the beginning of their vocational training, not after they have been half trained according to methods that are probably inconsistent with his. Both the higher age limit and the requirement of previous training are reasons for suspicion, but they are not proof. In the case of highly specialized tasks, the employer may desire to give the training in his specialty only, and in that case he would naturally desire beginners with a broad vocational training secured elsewhere.

Some indications about the program can be secured from the requirement as to working hours. For low grade production work, where a boy merely counts as a unit, no different from any other unit, the absence of the boy is of no consequence. One may be absent for a day or for a week while another steps into his place. Any apprentice may be given work of this kind in part, but as soon as he advances to a position slightly above that of routine workers, the question of absence becomes a matter of importance. The willingness to accept special working schedules for apprentices suggests that the programs are of low grade, and purposely so.

Inadequate Program?

Another indication may be secured from the nature of the outside study desired by the employer. The desire that the apprentice be instructed in machine operations such as performed in the plant, indicates that the employer does not desire to give even this small amount of instruction. The desire that the apprentice be given mechanical drawing suggests a narrow apprenticeship program in which the instruction is confined to the immediate job. The desire that only cultural subjects be taught in outside class rooms shows that the employer thinks that he is giving a complete vocational course. But it should be borne in mind that these indicate only the attitude of the employer toward his program. The employer may be entirely satisfied with a program that is far from adequate.

Indifference toward outside instruction, such as the willingness to permit school officials to determine what instruction should be given, suggests indifference toward the program as a whole. While the public officials may, in some cases, know more about the kind of instruction needed, and while the employer should always welcome their advice and cooperation, the employer who really cares about the value of his program, and who intends to take the responsibility for its success, will be reluctant to relinquish control of an important part of it.

A detailed outline should be viewed with suspicion. In a factory engaged in routine production it is a simple matter to make an outline of the particular tasks that the boy will be given to do. The boys may be fed through the system, changing regularly according to schedule, as each boy steps into the place of the one who moves on. This is not possible with high grade apprenticeship. As soon as a boy is taken out of routine work, he cannot be kept on a routine program. He must do the work that is available when it is available. If he is given emergency repairs he must do it when the emergency arrives. If he is to work on development he must work on it when the development is being carried out. And boys are different. If a boy is to be given work according to his ability, no one knows this ability in advance and consequently the work cannot be planned in detail in advance. A real apprentice system does not demand consistent profit from the boy's labor.

The handling of boys in groups also suggests apprenticeship of a lower grade. A part of the training is always of a low grade, and this may be handled in groups when more convenient. But high grade work is not done on the mass production basis, or at least when the product is of high grade quantity production methods result in subdivision until each operation is of low grade. With work of a high grade there are only a few men engaged in each place, so it would be impossible to add a group of apprentices.

The Real Test

In conclusion, there are marked differences between real apprenticeship and its imitation, but they are differences of personal motives and attitudes which cannot be fixed by law or regulations. In listing the characteristic marks of imitation apprenticeship, I would call attention to the fact that every one of these is also found in some program of high grade. There are marks that lead us to suspect that a program is of low grade or an imitation, but the only real test is actual observation of the way in which the work and instruction is carried out. Among the natural characteristics of imitation apprenticeship are the following:

1. The requirement of preliminary vocational training;
2. The requirement of a high age limit for entrance;
3. Acceptance of an arbitrary limitation of hours without consideration of the specific needs of the task on which the apprentice is working;
4. Desire that the apprentice should have specific outside instruction in his occupation;
5. Indifference toward outside study, as a willingness to permit it to be controlled by others;
6. Too detailed an outline of the course;
7. Handling of apprentices in groups.

EDITORIALS

VOLUME 79 AMERICAN MACHINIST ESTABLISHED 1877 MCGRAW-HILL PUBLISHING COMPANY, INC. NUMBER 10

K. H. CONDIT F. H. COLVIN
EDITORS

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"Highly Significant"

THE WHITE HOUSE
WASHINGTON

April 23, 1935

My dear Mr. Condit:

May I acknowledge and thank you for the issue of American Machinist containing the supplement showing the total metal-working equipment in place in the United States as of the close of 1934 and the number of units in use which are more than ten years old.

I want to thank you particularly for giving me the benefit of the data you have assembled and published. I think it is highly significant that in 1925 forty four per cent of the Nation's metal-working equipment was more than ten years old; in 1930 this percentage had increased to forty eight per cent, and in 1935 it had risen to a total of sixty five per cent.

Very sincerely,

Franklin D. Roosevelt

Kenneth Condit, Esq.,
Editor, American Machinist,
330 West 42nd Street,
New York, New York.

Guns and Tools

A WARSHIP with guns that do not shoot straight is only a mild threat on the attack and a very insecure means of defense. Hence the crucial importance of a Naval Gun Factory adequately equipped to build guns that can be depended upon absolutely. Guns can be no better than the machines that make them.

The leading article in this issue describes the equipment problem of our main source of naval guns. The problem is acute. In the one item of gun lathes, for instance, no new ones have been purchased in nearly twenty years.

Some months ago Lieutenant Commander Walker, joint author of this article, wrote a longer one telling of the needs of all the Navy Yards for modern metal-working equipment. He points out here that of all the Yards the Washington Yard has the oldest machinery, and at the same time the most exacting requirements as to accuracy.

It is not impossible to do accurate work on old machine tools if they have been properly maintained. But it is almost sure to be vastly more expensive than accurate work done on an up-to-date machine, and there is always the likelihood of inconsistency because so much dependence must be placed on human skill in handling a cranky machine, and on hand work for final finishing.

Less than five per cent of the equipment in the Naval Gun Factory is under ten years old, which means that its adequacy for precision work is extremely doubtful. It means also that the taxpayer is charged far more than he should be charged for this essential phase of national insurance.

Two allotments from PWA funds have been requested, as described in our article. They are conservative and should be granted.

. CHIPS .

Washington—Frank Walker, Democratic campaign treasurer, appointed chief adviser on Works Fund distribution, Ickes, Hopkins and Tugwell given subdivisions . . . NRA drops production control and most of its price fixing, Senate Finance Committee gives it until April, 1936, instead of two years . . . Ickes baiters in Congress take a good look at the new funds he will have to spend and vote him the $10,000 under-secretary he asked for . . . LaFollette demands confiscatory taxes, business leaders promise recovery if restrictions are removed . . . Battle drawn between reform and recovery . . . CCC will be first agency to put Work Bill funds to use, gets $190,000,000 . . . Roosevelt appoints cabinet committee to study textile and cotton question, emphasizes obsolete equipment . . . Inflationists open Congress drive with bonus bills.

Foreign—120,000 French recruits of 1914 class are called to the colors for training . . . Wild tales of Germany's preponderant air strength give other European nations the jitters . . . Goering lauds its quality rather than its size . . . Hitler repeats his pronouncement that Germany seeks peace with neighbors . . . Submarine school at Kiel resumes training activities . . . Nazis consolidate control of newspapers . . . Another political kidnapping, this time in Czechoslovakia, threatens trouble . . . England plans Arabian canal to break French stranglehold through Suez control . . . Soviet newspaper condemns official ineptness as cause of high factory costs . . . 700 planes stage Moscow demonstration at huge May Day rally . . . French and Russian envoys finally sign mutual assistance agreement . . . Reichsbank directors warn Hitler to reduce expenditures . . . Shortage of essential raw materials is slowing down rearmament progress . . . Italy continues mobilization activity . . . Great Britain to strengthen air force at once, up to German level.

Finance—U. S. raises silver price again as markets boom . . . S.E.C. eases restrictions on financial advertising . . . Bank clearings up 7 per cent to high for 1935.

Industry—Toledo Chevrolet strike causes no disorder as plant is closed but leads to shutdowns at other plants as reserve supplies are used up, and may mean the transfer of operations to Muncie and other General Motors units . . . Racine citizens call on mayor to demand police control of strikers as two big plants plan to close permanently and move out of state . . . Chrysler reports largest quarter in history of corporation . . . New high speed trains and locomotives delivered to New Haven and Milwaukee roads . . . Others nearly ready for B. & O. . . . Burlington puts two more Zephyrs into service . . . Hearings on crucial Schechter poultry case which is to bring ruling on constitutionality of NRA held before U. S. Supreme Court.

Trade—Hull condemns selfish interests in defending his reciprocal tariff policy before U. S. Chamber . . . Opens tariff negotiations with France . . . Sends note to Germany, inviting trade conference.

Indicators—Steel production and electrical power output decline slightly. *Business Week's* index drops 0.7 point to 62.3. Carloadings improve.

Cleveland Picked for Metal Trades Meeting

Several timely subjects will be discussed at the 37th annual convention of the National Metal Trades Association at Cleveland, May 15-16. Headquarters for the convention will be the Hotel Cleveland. Topics and speakers for Wednesday, May 15, are: "Appraisal of the NRA," Gilbert H. Montague, New York attorney; "Practical Treatment of Industrial Relations Problems," Louis Ruthenburg, president of Servel, Inc., and discussions by George Seyler, The Lunkenheimer Co. and C. S. Craigmile, vice-president in charge of production, the Belden Mfg. Co. In the afternoon the program will be: "How to Retard Recovery," W. B. Bell, president of the American Cyanamid Co.; "Facts and Fairies," James Emery, general counsel of the Association; "The Threat of Political Banking to the Durable Goods Industry," Malcolm Muir, president of the McGraw-Hill Publishing Co., Inc.; and "Transportation and Business Recovery," Judge R. V. Fletcher, vice-president and general counsel, Association of American Railroads. The annual dinner will be held the same evening.

On Thursday morning, May 16, the program will be: "Economics of the New Deal," Prof. O. G. Saxon, Yale University; "Americanism and Communism," Hamilton Fish, Jr., congressman from New York: "Prosperity and Social Security," Prof. E. S. Todd, Miami University.

Inspection to Be Topic at A.G.M.A. Spring Meeting

According to an announcement by B. F. Waterman, Brown & Sharpe Manufacturing Co., chairman of the program committee, the following papers will be presented at the annual meeting of the American Gear Manufacturers Association, to be held at the Penn-Lincoln Hotel, Wilkinsburg, Pa., on May 14 and 15:

Methods for Checking Gears—Douglas T. Hamilton, Fellows Gear Shaper Co., in collaboration with Robert Beardsley, Jones & Lamson Co.

Inspection Methods that Give a New Conception of Gear Accuracy—S. O. Bjornberg, Illinois Tool Works.

Heat-Treatment of Miscellaneous Gearing—Jordan Korp, Leeds & Northrup Co.

Science of Seeing—one of General Electric Co.'s engineers.

New Machine for Finishing Gears by Rotary Shaving Process—R. S. Drummond, National Broach & Machine Co.

British Standards (with particular reference to worm gears)—Prof. Earle Buckingham, Massachusetts Institute of Technology.

British Standards (with particular reference to bevel and spiral bevel gears)—F. E. McMullen, Gleason Works.

Business Bucks the New Deal WAD and CCC Get Going

WASHINGTON—Business came to Washington for the meeting of the Chamber of Commerce of the U. S. to find a way to prevent the Administration from blocking recovery through efforts to push through reform legislation at any cost. It demanded that the New Deal show its hand; that business have a chance to do its part in recovery; that the Administration quit threatening all sorts of vague things that dampen enthusiasm and enterprise.

It was evident that business is ready to fight along all fronts. The new president, Harper Sibley of Illinois, was elected because he believes in an aggressive policy, and says so. Critical speeches attacked the NRA, the utilities holding company bill, the social security bill and the banking bill.

Despite Secretary Roper's gallant effort to reassure business that the New Deal had no intention of destroying business, the talk outside of the meetings was all about what the government had done to business and the remarks were not flattering. Some of the cooler heads are disturbed by the critical tone of the resolutions adopted and by the conspicuous absence of a welcoming message from the President. The President dismissed the whole matter by saying that he does not believe the Chamber speaks for business.

Speaking before the group interested in durable goods and housing on the subject "Equipment Needs of American Industry," John W. O'Leary, president, Machinery and Allied Products Institute, repeated the statistics on deferred purchasing of capital goods gathered from various sources including *American Machinist, Electrical World* and his own organization. Commenting on the handicaps to business imposed by such administrative interpretations as those authorized in the Vinson Act, which limits profit on Navy contracts to 10 per cent, Mr. O'Leary pointed out that the practical effect is to bring the possible profit to a very small figure and the potential loss risk to a very large one.

Further evidence of the "repudiation of NIRA" came when the Senate Finance Committee voted 16 to 4 for a compromise extending it to April 1, 1936, striking out price fixing provisions, except those applying to mineral resources, and eliminating intrastate commerce from its control. The size of the vote is taken to indicate the probable action of the Senate on the report. At the same time, observers close to the situation believe that the threat of adding the Wagner Bill as an amendment is lessened if not removed.

The Supreme Court listened to arguments in the famous Schechter poultry case which has been chosen as the NIRA test case, and indicated by its questions that it may rule the law unconstitutional on the ground that Congress delegated too much authority.

By the time this item is published the Senate will probably have passed one of the three competing bonus grab bills before it. The President is expected to veto a bonus bill and the question will then be whether the Legion lobby and the politicians can muster votes enough to override the veto. After all, there is an election next year and the lobby knows how to "put on the heat."

President Roosevelt called his first meeting of the "round table" on work relief yesterday and has announced that he expects to have the program in full swing by October or November. The amount to be apportioned for work relief has been augmented by $1,500,000,000 unexpended by PWA.

Enrollment in the CCC to bring the corps up from 350,000 to 600,000 men will begin on June 15 but the expansion program is already underway; $190 millions will be spent by June 30. Automotive and heavy equipment already contracted for to meet the needs of the expansion program totals $20.8 millions, includes 3,950 trucks (Army); 8,050 stake body trucks; 5,852 dump trucks; 2,819 pick-up trucks; 464 automobiles; 520 ambulances; 1,291 tractors; 1,060 tractor trailbuilders; 1,087 power graders, 562 compressors, 699 jack (air) hammers; 60 power saws; 47 power scrapers; 8 power shovels and draglines; 48 concrete mixers and several hundred other items.

May Auto Schedules Indicate Promising Equipment Prospects

DETROIT—The automobile assembly industry is continuing the record breaking pace set in the first quarter of the year, although indications now are that a plateau in production has been reached. Schedules for May will reflect little change in the current rate; June is problematical but not likely to show the sharp reduction encountered last year. In fact, some June schedules were projected a few weeks ago at substantially the current rate. However, less pressure is being put upon suppliers, indicating an even production with a leaning toward reduction of inventory.

March output was 451,805 and April is expected to better this figure by several thousand. March sales of passenger cars will be close to 260,000 and April is expected to top the 300,000 mark. Truck sales are at the same rate. With sales of 41,000 estimated for March, both production and sales are substantially better than the high rate established last year. The number of commercial and delivery cars sold is accepted as an indication that small business is displaying substantial recovery. Ford trucks and commercial car sales in the first quarter were 116 per cent above last year while Chevrolet sales for the same period were exceeded only by the first quarter of 1929.

Random samples indicate increased absorption in retail sales with substantial banks of unfilled orders still in evidence. Cadillac-LaSalle reports unfilled orders of 3,000 as of April 19, Packard 120 model, 8,000, Chrysler 102,000 for all units and Chevrolet started April with 74,500 orders on hand. Retail deliveries of Pontiacs the second ten days of April were 16 per cent above the previous 10-day period, and Buick 52 per cent.

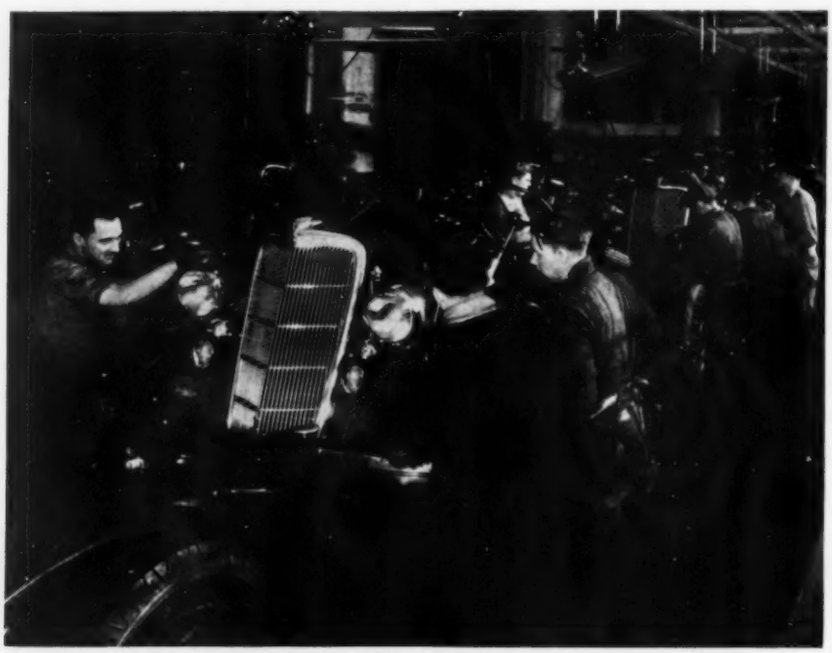
While the number of used cars is giving concern, it is pointed out in a recent release of the N.A.D.A. that 52 per cent of the used cars last year were sold between April 1 and September 1. In an analysis of 3,500 recent new car sales by the Pontiac Motor Company, 43.7 per cent of all cars turned in were over three years old. The volume of retail financing increased 35 per cent in March over February while last year the increase was 33 per cent.

Latest figures on export of automobiles released by the Department of Commerce indicate an increase of February over January of 19 per cent, or 21,710 units as compared with 17,500. The February figure this year is 56 per cent better than that of last year.

The strike called April 23 by the United Automobile Workers Federal Union, an A. F. of L. affiliate, at the Toledo Chevrolet transmission plant and which on April 29 spread to the Cincinnati Chevrolet plant is the only apparent cloud on the labor horizon. Despite the seniority and layoff plan promulgated by the President in March a year ago and since administered by the Automotive Labor Board, the Union demands that the Union Committee supervise layoff and retiring lists at the plant. The strike was called by local union officials after the auto board primary, but before the final election for bargaining representatives was held. In addition to this supervision, a pay increase and a contract signed with the Union are demanded. It is significant that this is one of the very few plants where union affiliation apparently won out in the primary elections; the completed canvass of 163,150 assembly plant workers indicates an A. F. of L. strength of 8.6 per cent and a total union strength of 17.1 per cent.

The management has proposed operation according to the President's settlement with a pay increase, although the average pay rate is now stated to be above that paid in 1929 and higher than paid in other plants, but has refused to sign a contract with the Union. Acceptance of these terms has been refused and negotiations are still being carried on.

This development is apparently local in character with no relation to the earlier trouble at the Fisher plants in Cleveland. Widespread disorder disrupting the President's settlement would more than likely affect administrative support for the Wagner Bill, a condition which higher A. F. of L. officials wish to avoid. This, with the preponderance of unaffiliated workers in other places, leads to the belief that the trouble will be localized.



***Still Going Strong*—Despite hesitancy in other industries, Detroit keeps its chin up and its assembly lines busy. Ford is producing more than 6,000 cars and trucks daily; made 550,000 between January 1 and April 30**

Parts Making Spread

That General Motors is not likely to take the chance of having an extensive Chevrolet tie-up result from this strike is evidenced by the sudden placing of orders for machine tools to be shipped to the plant of Muncie Products in Indiana. It is evidently going to be the policy to assign manufacturing of a given subassembly to several plants to avoid embarrassment arising from labor trouble in one plant. Rumors place the total equipment order as high as $1,000,000.

May business in production tools is

expected to be at about the same rate as March and April, but ordering now is for smaller quantities which implies working down of inventories.

The frequently repeated argument in this letter that increasing costs and the necessity for boosting bottle neck points in many places would force investment in equipment seems to be bearing fruit in the increased activity in the machinery line in the last few days. With two new motor lines on order, inquiries from a large unit hitherto quiescent being received and rush orders for expansion due to redistribution of production, the second quarter is expected to be much better than the first and very much ahead of the same period last year. Replacements and expansions account for the bulk of the interest.

The Michigan sales tax will adversely affect machinery and jobbing supply houses unless amendments to the law now before the Legislature are passed. The payment of 3 per cent on the sales tax price of supplies and equipment used in the production of a taxable product will lead manufacturers to place business outside the state. The tax heretofore has been reported but not paid pending a hearing.

A further uncertainty is the future of N.R.A. With 75 per cent of the business of the country under code price policies cannot be determined ahead with any certainty and the chaos in the price structure likely to result from its abandonment is a drag on industry, especially the heavy industries.

Unwise Credit Policies

As a means of protecting the jobbing die shops against wild bidding of competitors sustained by over liberal and unwise credit policies of supply houses, a movement is on foot to call to the attention of suppliers of this industry the results of such a policy. Instances are on record of jobbers exhausting one line of open book credit through failure to pay being accorded the same privilege by other suppliers without adequate examination, an uneconomic and disrupting situation since in the meantime the non-paying jobber is taking business away from those who meet their bills.

With a differential in hourly rates available for the better workers efficiency per man hour has not decreased under the day rate is the experience to date of one of the large units in the industry.

General Motors earnings for the first quarter this year were slightly better than last year, 68c. per share being earned as compared with 63c. although sales to consumers in the United States showed an increase of 43 per cent and a world increase of 23 per cent. Hudson Motor Car Company reports first quarter operations on a profitable basis. The Chrysler Corporation reported a net profit for the quarter of $9,163,182, against $3,303,850 last year.

J. J. Crowe Elected Head of Welding Society

At the sixteenth annual meeting of the American Welding Society in New York, April 25, it was decided to take over the American Bureau of Welding because the National Research Council finds itself unable to sponsor the work any longer. Dr. D. S. Jacobus of Babcock & Wilcox Co., and retiring president, received the past-president's medal. J. J. Crowe, Air Reduction Sales Co., was elected president, and E. R. Fish, Hartford Steam Boiler Inspection & Insurance Co., senior vice-president.

R. M. A. Spring Meeting to Be at Hot Springs

Members of the Refrigerating Machinery Association will meet at The Homestead in Hot Springs, Virginia, May 23-25, for their annual spring meeting. On the morning of May 23, the Refrigerating Machinery Industry will hold its annual meeting and elect the code authority for the coming year. For the same day is scheduled a joint luncheon of the National Electrical Manufacturers Association, the R.M.A. and the Air Conditioning Manufacturers Association. Prentiss Coonley, code administration officer of the NRA, will be guest speaker. The afternoon is set aside for meetings of various R. M. A. subdivisions and for the meeting of the Air Conditioning Manufacturers' Association. On the morning of the 24th, D. Norris Benedict of the Frick Co., Inc., and president of R. M. A., will sound the keynote "Looking Forward." Open forum discussions of the future policies of the association will follow.

• INDUSTRIAL REVIEW •

• While those in the machinery and machine tool industries are not expressing the same enthusiastic optimism for the immediate future that is firing General Dawes, they are much encouraged by a good April business and are looking forward to a moderately busy summer. Many companies had the best business in April they have had in five years and some few say that April business established a new high record. As a result the already serious shortage of certain types of skilled men is causing real concern.

• New England experienced a slowing down during the past three weeks which was apparently caused by a sudden wave of caution that swept over industry. New York and the metropolitan area had a very fair business and some improvement was noted in the Philadelphia territory. Slacking off of steel mill operations in and around Pittsburgh has reacted on machinery business but some orders were placed and many more are pending.

• Machine tool and supply business is better in Cincinnati but no great advance is likely until the automobile strike threats clear away. Cleveland is in much the same situation, some of the parts makers and steel suppliers there having had to curtail operations because of the Toledo fracas. Detroit tool companies are busier and several important machinery programs are up. Everyone is watching General Motors to see how the Chevrolet troubles are going to be handled. Machine tool orders have dropped off.

• Despite the Chevrolet strike many Toledo plants have been busier but even so there is not much interest in new equipment. Employers generally are apprehensive of further labor trouble. In Indianapolis a fair amount of business has been placed and prospects are fairly satisfactory. The chances are that the second quarter will hardly match up with the first. St. Louis reports an encouraging April and enough business in sight to indicate that no serious slump is ahead.

• In Chicago promising deals are being held up by the widely heralded business uncertainty. Distributors believe that much of this business will be released when Congress adjourns. Milwaukee business in machine tools was good in April and bids fair to hold up well during May. Much the same situation exists both in the San Francisco territory and in the Pacific Northwest. Barring political disturbances the prospects for an active summer are considered to be excellent.

Machinery Exports Increased 78 Per Cent During 1934

After continuous declines from a peak of $277,765,000 in 1929 to a low of $55,248,000 in 1933, United States exports of machinery turned upward to $98,349,000 in 1934. This was a gain of 78 per cent over the 1933 figure, and while it was only 36 per cent of the 1929 figure, the character of the trade was such as to point to a definite turning point for the better in almost every market, according to E. V. Needham, Machinery Division, Commerce Dept.

During 1934, 82.5 per cent of the machinery export business went to twenty countries. A similar condition has prevailed for the past six years. In 1933, the same countries took 83 per cent; in 1932, 86 per cent; in 1931, 88.5 per cent; in 1930, 73.7 per cent, and in 1929, 82.3 per cent.

Exports of American Industrial Machinery to Twenty Leading Countries

(Values in Thousands of Dollars)

	1934	1933	1932	1931	1930	1929
France	7,063	3,870	4,906	4,619	8,564	12,070
Germany	1,705	1,085	723	5,283	5,438	7,202
Italy	1,604	1,147	1,121	1,256	2,415	3,970
Russia	3,881	1,392	5,903	38,941	39,974	14,066
United Kingdom	11,777	6,807	9,210	19,912	22,313	27,770
Canada	15,059	8,153	10,837	25,053	46,791	69,544
Mexico	7,590	4,930	3,216	5,131	12,969	14,503
Netherland West Indies	1,338	770	217	1,650	1,185	3,821
Argentina	3,488	3,007	2,211	3,366	8,177	9,948
Brazil	2,561	1,328	1,062	1,278	4,180	7,208
Chile	1,194	285	201	2,557	7,188	6,902
Colombia	2,087	1,352	1,138	1,458	1,823	4,708
Venezuela	4,076	2,187	1,172	1,748	5,369	9,188
British India	2,003	1,059	1,136	2,256	3,347	4,433
China	1,611	828	706	1,194	1,670	3,019
Netherland India	1,278	265	160	1,162	2,907	4,530
Japan	5,155	2,971	2,393	3,431	6,452	8,391
Philippine Islands	2,425	2,002	1,741	2,328	3,350	5,459
Australia	2,008	944	1,006	969	3,635	7,106
South Africa	3,290	1,577	1,151	1,880	2,642	4,546
Total	81,193	45,959	50,210	125,472	190,389	228,384
All Other	17,156	9,325	8,281	16,363	37,902	49,381
Grand Total	98,349	55,284	58,491	141,835	228,291	277,765

Exports of Machinery During March, 1935

	March 1935	February 1935	March 1934
Electrical machinery	$6,635,810	$5,206,548	$5,593,785
Power generating machinery (except automotive and electric)	721,692	570,995	400,993
Construction and conveying machinery	536,163	479,274	443,264
Mining, well and pumping machinery	3,147,378	2,108,730	1,717,902
Power-driven, metal-working machinery	*1,964,620	1,606,668	1,996,535
Other metal-working machinery	222,156	155,688	257,976
Textile machinery	717,487	422,644	682,485

Exports of Metal-Working Machinery During March, 1935

	March 1935	February 1935	March 1934
Engine lathes	$85,646	$40,236	$94,770
Turret lathes	136,914	77,624	28,393
Other lathes	64,192	39,445	49,702
Vertical boring mills and chucking machines	37,302	67,250	73,547
Thread cutting and automatic screw machines	69,987	76,120	92,525
Knee and column type milling machines	106,961	67,963	67,882
Other milling machines	76,281	101,862	144,334
Gear cutting machines	129,417	66,468	181,330
Vertical drilling machines	12,668	11,890	47,310
Radial drilling machines	17,949	10,500	290
Other drilling machines	88,600	66,521	54,041
Planers and shapers	55,879	18,604	40,534
Surface grinding machines	57,574	37,757	16,605
External cylindrical grinding machines	56,140	57,892	151,039
Internal grinding machines	99,470	80,073	104,584
Tool grinding, cutter grinding, and universal grinding machines	80,203	167,606	29,942
Other metal-grinding machines	65,335	18,791	50,122
Sheet and plate metal-working machines	141,444	81,082	368,640
Forging machinery	255,123	125,422	25,103
Rolling mill machinery	71,327	141,685	28,103
Foundry and molding equipment	28,748	57,222	39,340
Other power-driven metal-working machinery and parts	227,460	194,652	308,399
Other Metal-Working Machinery			
Pneumatic portable tools	66,924	52,394	41,849
Other portable and hand or foot operated metal-working machines and parts	58,822	46,852	50,128
Chucks for machine tools	14,309	11,612	10,980
Machine operated pipe and thread cutters, stocks, dies, taps and other machine-operated cutting tools	42,601	26,267	134,622
Other metal-working machine tools	39,500	18,563	20,397

The 1934 trade with Europe amounted to $32,294,000 as compared with $18,240,000, a gain of 77 per cent and an amount nearly 38 per cent of the 1929 total, and 35 per cent of the 1930 total. The United Kingdom, France, Russia, Italy, and Germany were the largest markets, all showing sizeable gains during the year. Although shipments to the remaining markets in no case exceeded a million dollars, most of them recorded gains. In fact, the only important machinery markets which failed to exceed their 1933 purchases were Belgium, Spain and Poland.

Asia, during 1934, was the second largest market for American machinery. The trade amounted to $15,912,000, a gain of 94 per cent over the $8,217,000 exported in 1933. The 1934 figure was nearly half the amount exported in the peak year 1929, when the trade amounted to $32,618,000. Exports to Japan, China, and India almost doubled in value from the 1933 totals.

The trade with Latin-America in 1934 was valued at $27,825,000 as compared with $17,309,000 in 1933, a gain of 61 per cent. The 1934 amount was 38 per cent of the trade in 1929. The brightest spots in this area are Brazil, Colombia, and Mexico. Brazilian cotton expansion is, at the moment, perhaps the most interesting development from the standpoint of American machinery, offering an opportunity for the sale of cotton ginning machinery, oil mill equipment and certain types of textile plant installations.

Foundry Machine Orders Drop Again in March

With an index of 68.0 for March as compared with 74.2 for February, foundry equipment orders showed another drop, in this instance of 8 per cent. As a result the index is now below that for March, 1934, when it stood at 75.4.

Shipments were also lower in March, the index being 82.6 as compared with 85.1 for February, but were above those of March 1934, at 62.6. Unfilled orders fell to 43.2 as compared with 57.7 in February and 51.5 a year ago.

The three months' average of gross orders was slightly higher at 77.2 as contrasted to 76.4 for February and 59.5 for March, 1934. These figures are based on twenty-two reports by manufacturers to the Foundry Equipment Manufacturers Association.

L. J. KLINE

F. W. BIERWIRTH

C. O. HEDNER

• PERSONALS •

LAWRENCE J. KLINE, general manager since 1928 of the Mercury Manufacturing Co., Chicago, Ill., makers of industrial tractors, trailers, lift trucks and other material handling equipment, has been elected vice-president and general manager. He joined the company in 1919.

A. L. PATRICK, formerly treasurer of the Cleveland Automatic Machine Co., Cleveland, Ohio, has been elected executive vice-president. H. E. NUNN, vice-president, was appointed vice-president in charge of sales, and WALTER F. BROWN and DAVID L. JOHNSON were re-elected president and secretary, respectively.

CHARLES M. POND, connected with the Pratt & Whitney Co. since 1903, has been elected vice-president. He became assistant manager in 1919 and manager in 1923.

SIDNEY G. MCALLISTER, first vice-president of the International Harvester Co., will succeed ADDIS MCKINSTRY as president. Mr. McKinstry has resigned because of ill health, but will continue as a director.

L. E. HESS, vice-president of the J. G. Brill Co., has been appointed executive vice-president of that company, and E. L. OERTER elected director and treasurer to succeed E. P. RAWLE.

HOWARD L. RICH, formerly vice-president of the Lynd-Farquhar Co., Boston, Mass., was elected president. HAROLD F. FURBER is secretary and treasurer. Directors are Messrs. Rich and Furber and FRANK C. GOODWIN.

FREDERICK W. BIERWIRTH was elected vice-president of the Western Electric Company and appointed works manager at Kearny, N. J. He succeeds STANLEY S. HOLMES who died recently. Mr. Bierwirth started as clerk in the Chicago plant in 1912, rose through various positions, and was made operating superintendent of the Kearny Works in 1929. He has been assistant works manager there since 1931.

VICTOR J. MILL, Baldwinsville, N. Y., vice-president and treasurer of the Lawrence Machine & Pump Works, Lawrence, Mass., has purchased controlling interest and will take over active control of the company. He has resigned as chief engineer and director of sales of the Morris Machine Works, Baldwinsville, but will continue as a member of the board.

EVARTS C. STEVENS has become president of the International Silver Co., Meriden, Conn. He was formerly vice-president of that company and succeeds the late CLIFFORD R. GARDINOR.

E. C. MANNING, Fisher Body Co., Cleveland division, has been elected president of the Purchasing Agents' Association of Cleveland. The association has appointed W. G. WINSHIP, Foote-Burt Co., as vice-president; F. MEKET, Aluminum Co. of America, second vice-president, and G. A. COLLIER, Cleveland Automatic Machine Co., as treasurer.

N. W. PICKERING, president of Farrel-Birmingham Co., Inc., Ansonia, Conn., and Buffalo, N. Y., sailed early last month for a two months' trip abroad. He will spend some time with the company's representatives in England, France, Sweden and Norway and other European countries.

CARL O. HEDNER, Philadelphia division of The Yale & Towne Manufacturing Co., has been elected chairman of the Electric Hoist Manufacturers Association. Mr. Hedner has been identified with Yale & Towne since 1923. He was district manager of the Southeastern territory and recalled to the home office as manager of sales, a position he still holds.

• OBITUARIES •

CHARLES R. HOLMAN, formerly treasurer of the Holyoke (Mass.) Machine Co., died. Mr. Holman was 70 years old.

MAINOR S. MELVILLE, 52, works manager of the Benedict Manufacturing Co., East Syracuse, N. Y., died at Dewitt, N. Y.

PATRICK J. MOOHAN, works manager of the Nash Motor Co., Kenosha, Wis., since 1916, died April 25 at the age of 56. Mr. Moohan came from Canada to Detroit as a boy, and worked there later with Henry Ford developing the "999" racing car.

CHARLES AUGUST PAESCHKE, president and, in 1880, one of the founders of Geuder, Paeschke & Frey Co., Milwaukee, Wis., died April 28. Mr. Paeschke was born in Milwaukee in 1857.

CHARLES A. WEAVER, 68, founder and president of the Metal Stamp & Fixture Co., Batavia, N. Y., died recently. He established the company in 1916.

LEWIS B. WHITE, inventor of Ring traveler machinery and formerly associate owner of Fisher, White Co., Riverside, R. I., died April 25. He was 80 years old.

• MEETINGS •

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Annual meeting, May 14-15. Penn-Lincoln Hotel, Wilkinsburg, Pa. J. C. McQUISTON, manager-secretary, Penn-Lincoln Hotel, Wilkinsburg, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Summer convention, June 24-28. Ithaca, N. Y. H. H. HENLINE, national secretary, 29 West 39th St., New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Summer meeting, June 19-21. Cincinnati, Ohio. CLARENCE E. DAVIES, secretary, 29 West 39th St., New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 24-28. The Book Cadillac Hotel, Detroit, Mich. C. L. WARWICK, secretary, 260 South Broad St., Philadelphia, Pa.

NATIONAL METAL TRADES ASSOCIATION. Annual meeting, May 15-16. Hotel Cleveland, Cleveland, Ohio. HARRY S. FLYNN, secretary, Peoples Gas Bldg., Chicago, Ill.

REFRIGERATING MACHINERY INDUSTRY. Annual meeting, May 23. The Homestead, Hot Springs, Va.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual meeting, June 16-21. The Green Brier, White Sulphur Springs, W. Va.

• BUSINESS ITEMS •

The Stewart Die Casting Corp., Chicago, Ill., a unit of the Stewart-Warner Corp., has been consolidated with the Bassick Co., Bridgeport, Conn., and will move to the Railroad Avenue plant, of that city. SIDNEY L. BELLINGS is president of the Stewart Die Casting Corporation, which will continue to function under that name.

The machinery and equipment of the Flather Co., Nashua, N. H., makers of engine lathes, is being liquidated at the plant. The disposal of this equipment is being handled by the Wigglesworth Machinery Co., 199 Bent St., Cambridge, Mass.

The Charles Bond Co., Philadelphia, Pa., manufacturers of stock gears, sprockets and speed reducers, and the Bond Foundry & Machine Co., Manheim, Pa., makers of hangers, couplings, pillow blocks and power transmitting specialties, have appointed Carter, Milchman & Frank, Inc., 139 Spring St., New York, N. Y., as distributors in the New York territory.

Corporation Reports

Company	1934 Earnings	1933 Earnings	1935 Earnings First Quarter	1934 Earnings First Quarter
Airway Electric Appliance Co.			*d*$51,522	$9,549
Allis-Chalmers Mfg. Co.			*d*$22,242	$677,153
Auburn Automobile Co.			**d*$451,597	**$857,395
Bendix Aviation Corp.			$803,537	$758,977
Briggs & Stratton Co.			$357,075	$210,313
Brill Co.	$9,050	$1,849		
Checker Cab Mfg. Co.	*d*$354,883	*d*$707,930		
Cleveland Automatic Mch. Co.	*d*$97,769	*d*$142,454		
Douglas Aircraft Co.			*$340,297	*$8,205
Ex-Cell-o Aircraft & Tool Corp.			$93,112	$136,076
Fairbanks Co.		*d*$112,849	*d*$238,552	
General Cable Corp.			*d*$126,318	*d*$329,796
General Electric Co.			$5,390,930	$4,565,728
General Motors Corp.			$31,510,371	$29,319,523
General Railway Signal			$96,371	*d*$180,447
Houdaille-Hershey Corp.			$902,869	$250,246
Hudson Motor Car Co.	*d*$3,239,201	*d*$4,409,229	$235,610	*d*$802,845
Hupp Motor Car Co.	*d*$4,398,444	*d*$1,777,588		
International Bus. Mch. Co.			$1,771,914	$1,688,849
Kelsey-Hayes Wheel Corp.			$506,429	$127,303
Kelvinator Corp.			$357,297	$305,517
Knott Corp.	$1,539	*d*$24,060		
Link-Belt Co.			$200,978	$118,076
Marion Steam Shovel Co.			*d*$119,552	*d*$131,711
Maytag Co.			$568,779	$460,381
Midland Steel Products Co.			$344,031	$70,857
National Cash Register			$196,775	$280,817
Otis Elevator Co.			$53,538	*d*$252,051
Reliance Mfg. Co.			$35,052	$145,197
Reo Motor Car Co.			$10,620	*d*$272,881
Seagrave Corp.			*d*$10,847	$12,242
Stewart Warner Corp.			$496,063	$167,495
United American Bosch			$63,102	$58,124
U. S. Hoffman Machinery			$20,924	$11,894
Westinghouse Air Brake Co.			*d*$174,250	*d*$271,723
Yale & Towne Mfg. Co.			*d*$9,676	$21,254

d—Deficit.
*—Quarter ended Feb. 28.

• PATENTS •

April 16, 1935

Metal-Working Machinery

Wire Wrapping Machine. Constantine A. Caldes, Jersey City, N. J., assigned to Anaconda Wire & Cable Co. Patent 1,997,626.

Machine Tool. Lyndon C. Cole, Hamilton, Ohio, assigned to General Machinery Co. Patent 1,997,810.

Two Slide Automatic Grinding Machine. Clifford T. Raule, Brookline, Pa. Patent 1,997,978.

Rotary Broaching Machine. Francis J. Lapointe, Ann Arbor, Mich. Patent 1,998,162.

Tools and Attachments

Universal Die Sinking Attachment for Horizontal Milling Machines. Edmund Leo Wall, Detroit, Mich., assigned to R. W. Glasner. Patent 1,997,891.

Adjustable Work Clamping Device. John M. Rusnak, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,997,916.

Processes

Treatment of Ferrous Metals. Wilbur R. Bennett, Maplewood, N. J. Patent 1,997,567.

Electric Arc Welding Method. Robert K. Hopkins, New York, N. Y., assigned to M. W. Kellogg Co., New York. Patent 1,997,969.

April 23, 1935

Metal-Working Machinery

Machine for Making Wire Rope or the Like. John P. Barclay, East Haven, Conn. Patent 1,998,430.

Drilling Machine. Andrew T. Dupont, Washington, D. C. Patent 1,998,451.

Grinder or Hone for Cylindrical Surfaces. John Edward George Kline, Grosse Pointe Farms, Mich., assigned to Hutto Engineering Co., Inc. Patent 1,998,460.

Machine for Twisting Metal Wires. Karl Johan Jensen, Nydalen, V. Aker, near Oslo, Norway, assigned to Gunnar Larsen. Patent 1,998,582.

Grinding Machine. Walter D. Archea, Cincinnati, O., assigned to the Heald Machine Co. Patent 1,998,603.

Apparatus for the Metal Lining of Pipes. Frederick A. Kormann, Glendale, Cal., assigned to Industrial Research Laboratories, Ltd. Patent 1,998,627.

Tube Jointing Machine. Theodore Briegel, Rock Island, Ill. Patent 1,998,653.

Lapping Machine. William D. Rundlett, North Adams, Mass., assigned to the James Hunter Machine Co. Patent 1,998,738.

Grinding Machine. Otho L. Giffin, Auburn, Mass., assigned to Johnson Steel & Wire Co., Inc. Patent 1,998,755.

Disk Grinding Machine. Grover C. Leach and Thomas R. Leach, Brownwood, Tex. Patent 1,998,783.

Machine for Shaping Herringbone Gears. Edwin R. Fellows, Springfield, Vt., assigned to the Fellows Gear Shaper Co. Patent 1,998,835.

Bolt Making Machine. William L. Clouse, Tiffin, Ohio, assigned to the National Machinery Co. Patent 1,998,979.

Press. Victor W. Peterson, Chicago, and Joseph E. Gregorich, Berwyn, Ill., assigned to Hannifin Manufacturing Co. Patent 1,999,057.

Wire Tying Machine. Ivan H. Spoor, La Grange, Ill., assigned to The Gerrard Co., Inc. Patent 1,999,144.

Tools and Attachments

Abrading Tool. Charles E. Sturgis, Rochester, N. Y. Patent 1,998,562.

Fluid Pressure Feeding Mechanism for Metal Working Tools. Edward Joslin Kingsbury, Keene, N. H. Patent 1,998,873.

Boring and Facing Tool Head. Charles B. Cole, Berwyn, and Otto L. Lewis, Chicago, Ill. Patent 1,998,893.

Processes

Process of Surface Plating of Metals with Alloys. Marcell Fiedler, Bound Brook, N. J. Patent 1,998,496.

Method for Forming Joints in Metal Tubing. Theodore Briegel, Moline, Ill. Patent 1,998,654.

Welding Electrode and Process of Making the Same. James M. Weed, Ballston Lake, N. Y., assigned to General Electric Co., Patent 1,998,947.

Die Rolled Article and Die Rolling Method. Thomas N. Sloan, Buffalo, N. Y., assigned to the Republic Steel Corp. Patent 1,998,970.

Method of Making Sheet Metal Staples. Harold S. Heller, Cleveland, Ohio, assigned to the J. C. Ulmer Co. Patent 1,998,991.

American Machinist

REFERENCE BOOK SHEET ©

American Standard Shafting and Stock Keys—I

Dimensions and tolerances for finished steel shafting, parallel stock keys and taper stock keys are to be published shortly by the American Standards Association. This standard is sponsored by the American Society of Mechanical Engineers, and is designated as B17.1—1935.

Standard sizes for finished shafting in diameters from ½ to 8 in. are given in Table 1. Three types of shafting are contemplated: (1) cold drawn, (2) turned and polished, (3) turned, ground and polished. The maximum diameter of 8 in. represents the practical upper limit for commercial stock products.

Two series of shaft diameters are included in Table 1 in order to meet more economically the requirements of two distinct applications: power transmission and general machine work. The diameters tabulated under the heading "Transmission Shafting" agree with the commercial sizes of bearings and couplings, and are usually supplied in the full stock lengths of 16, 20 or 24 ft. The series designated as "Machinery Shafting," which includes a larger number of sizes in the same range of shaft diameters, is intended for use in machine construction, and is generally desired in shorter lengths.

Table 1—Finished Transmission and Machinery Shafting

Stock Diameters		Tolerance[1]	Stock Diameters		Tolerance[1]
Transmission Shafting	Machinery Shafting	on Diameter (—)	Transmission Shafting	Machinery Shafting	on Diameter (—)
	½	0.002	2 7/16	2 7/16	0.004
	9/16	0.002		2½	0.004
	5/8	0.002		2 5/8	0.004
	11/16	0.002		2¾	0.004
	¾	0.002		2 7/8	0.004
	13/16	0.002	2 11/16	3	0.004
	7/8	0.002		3⅛	0.004
15/16	15/16	0.002		3¼	0.004
	1	0.002		3⅜	0.004
	1 1/16	0.003	3 1/16	3½	0.004
	1⅛	0.003		3⅝	0.004
1 3/16	1 3/16	0.003		3¾	0.004
	1¼	0.003		3 7/8	0.004
	1 5/16	0.003	3 13/16	4	0.004
	1⅜	0.003		4¼	0.005
1 7/16	1 7/16	0.003	4 7/16	4½	0.005
	1½	0.003		4¾	0.005
	1 9/16	0.003	4 11/16	5	0.005
	1⅝	0.003		5¼	0.005
1 11/16	1 11/16	0.003	5 7/16	5½	0.005
	1¾	0.003		5¾	0.005
	1 13/16	0.003	5 11/16	6	0.005
	1⅞	0.003		6¼	0.005
1 15/16	1 15/16	0.003	6½	6½	0.005
	2	0.003		6¾	0.005
	2 1/16	0.004	7	7	0.005
	2⅛	0.004		7¼	0.005
2 3/16	2 3/16	0.004	7½	7½	0.005
	2¼	0.004		7¾	0.005
	2 5/16	0.004	8	8	0.005
	2⅜	0.004	.....	.....	.....

All dimensions given in inches.

[1]NOTE: These tolerances are *negative* and represent the maximum allowable variation *below* the exact nominal size. For example the maximum diameter of the 1¼ inch shaft is 1.500 inches and its minimum allowable diameter is 1.497 inches.

Stock Lengths of Finished Transmission Shafting Shall Be 16, 20, and 24 Feet.

The dimensions, tolerances and stock lengths of plain taper keys are given in Table 2, for shaft diameters from ½ to 6 in., inclusive. The taper is ⅛ in. in 12 in., and shall run the full length of the key, *L*.

(The remaining data will be published soon.)

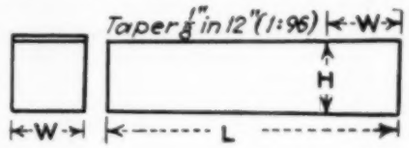


Table 2—Dimensions of Square and Flat Plain Taper Stock Keys[1]

Shaft Diameter (Incl.)	Square Type		Flat Type		Tolerance[1]	
	Maximum Width W	Height at Large End[2] H	Maximum Width W	Height at Large End[2] H	On Width (—)	On Height (+)
½– 9/16	⅛	⅛	⅛	1/32	0.0020	0.0020
5/8– 7/8	3/16	3/16	3/16	1/16	0.0020	0.0020
15/16–1¼	¼	¼	¼	1/16	0.0020	0.0020
1 3/16–1⅜	5/16	5/16	5/16	¼	0.0020	0.0020
1 7/16–1¾	⅜	⅜	⅜	¼	0.0020	0.0020
1 15/16–2¼	½	½	½	⅜	0.0025	0.0025
2 5/16–2¾	5/8	5/8	5/8	7/16	0.0025	0.0025
2 7/8–3¼	¾	¾	¾	½	0.0025	0.0025
3 3/8–3¾	7/8	7/8	7/8	5/8	0.0030	0.0030
3 7/8–4½	1	1	1	¾	0.0030	0.0030
4¾–5½	1¼	1¼	1¼	7/8	0.0030	0.0030
5¾–6	1½	1½	1½	1	0.0030	0.0030

All dimensions given in inches.

[1]NOTE: Stock keys are applicable to the general run of work and the tolerances have been set accordingly. They are not intended to cover the finer applications where a closer fit may be required.

[2]NOTE: This height of the key is measured at the distance W, equal to the width of the key, from the large end.

Fig. 3—Stock Lengths of Plain Taper Stock Keys

Shaft Diameter (Incl.)	Length of Key,[1] L						
½– 9/16	½	¾	1	1¼	1½	1¾	2
5/8– 7/8	¾	1⅛	1½	1 7/8	2¼	2⅝	3
15/16–1¼	1	1½	2	2½	3	3½	4
1 3/16–1⅜	1¼	1⅞	2½	3⅛	3¾	4½	5¼
1 7/16–1¾	1½	2¼	3	3¾	4½	5¼	6
1 15/16–2¼	2	3	4	5	6	7	8
2 5/16–2¾	2½	3¾	5	6¼	7½	8¾	10
2 7/8–3¼	3	4½	6	7½	9	10½	12
3 3/8–3¾	3½	5¼	7	8¾	10½	12¼	14
3 7/8–4½	4	6	8	10	12	14	16
4¾–5½	5	7½	10	12½	15	17½	20
5¾–6	6	9	12	15	18	21	24

All dimensions given in inches.

[1]NOTE: The minimum stock length of keys is equal to four times the key width and the maximum stock length is equal to sixteen times the key width. The increments of increase in length are equal to twice the width.

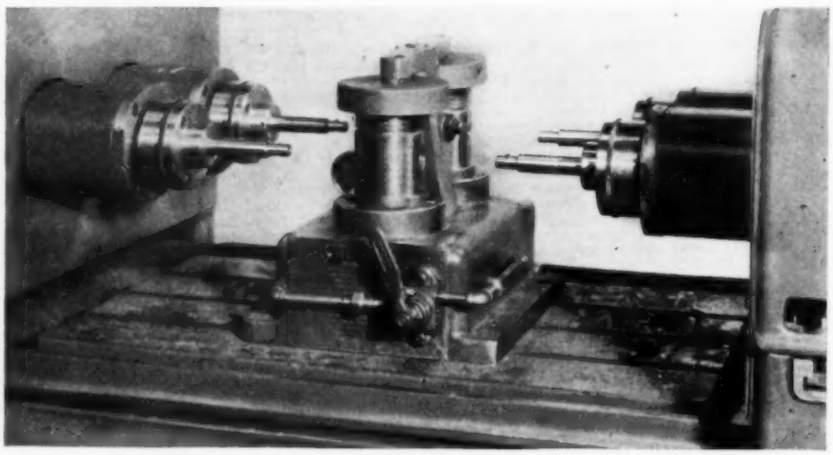
Three Precision Boring Jobs

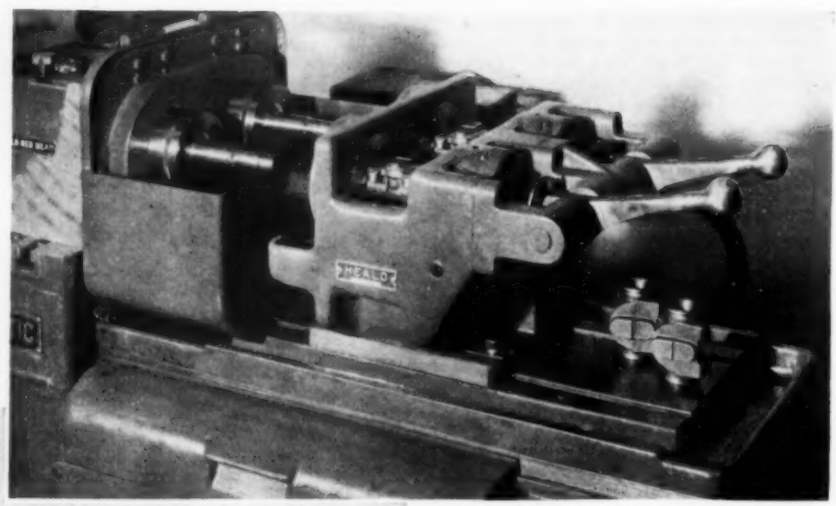
A change in method resulting from developments in the precision boring machine

THE increase in the use of single-point tools is strikingly brought out in the three jobs illustrated. All of these jobs were originally reamed. The change of method can probably be attributed to two fairly recent developments; precision boring machines with large, stiff spindles and bearings that can be kept in alignment, and cemented carbide for the tipping of the boring tools.

The first operation, Fig. 1, is the boring of piston-pin holes in automobile pistons. A self-locating, air-operated fixture reduces handling time to a minimum. One set of spindles roughs the holes in both sides of the piston. By taking two cuts, the pistons need only rough drilling before they come to this machine. The first cutters leave a very small amount for finish, insuring extreme accuracy in the finished hole. The boring bars are held in special offset boring heads with micrometer adjustments to tenths of thousandths.

In Fig. 2 is a special, two-spindle machine for finish boring two diameters in the independent brake cylinder for the wheel units of hydraulic braked cars. The cylinder is centered by a





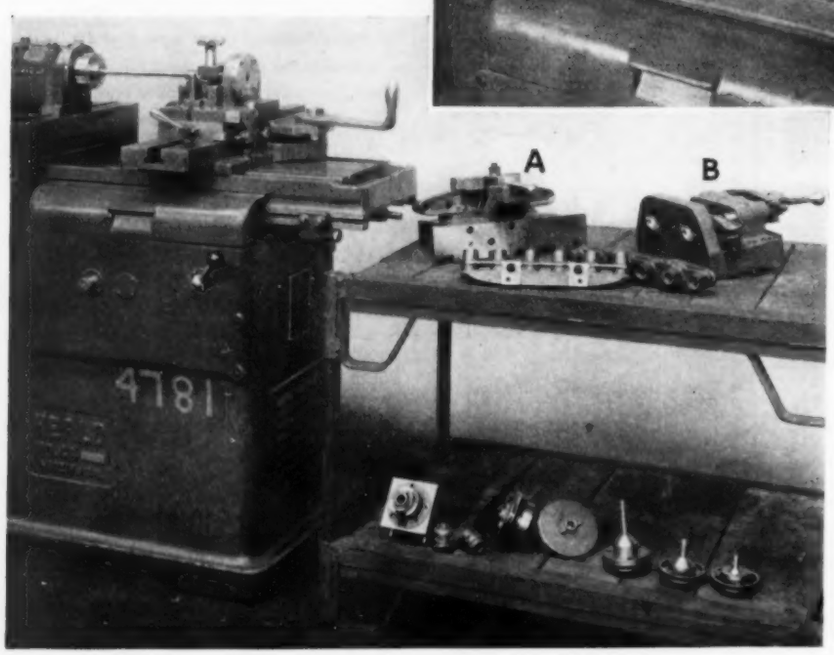


Fig. 1, top—These pistons are rough and finish bored at one setting. First the roughing bar bores both sides, and is followed by the finishing bar. Fig. 2, center—Boring two independent wheel brake units at once. These have two diameters and are finished at one operation. Fig. 3, left—Semi-universal Heald "Bore-Matic" for a variety of work, which indexes to each of six holes of a valve-lifter guide

chamfer on the front end and held by a cam clamp, controlled by the levers shown. It has been found advisable, however, to finish the master cylinder bore by grinding, on account of its length. The diameter and length of the master cylinder do not permit the use of a bar stiff enough to insure the accuracy desired.

In Fig. 3, a precision boring machine is used on a variety of jobs. As shown, it is boring a single valve lifter guide. Replacing this fixture with the one on the shop truck, at *A*, the valve lifter bracket, with its six holes 0.6375 by 1.8125, is bored and indexed. The stock removed is 0.015 in. and the tolerance is 0.001 in. for round, and half that for straight. Because of the rapid handling fixture, seventeen of these brackets are bored per hour. Positioning is by six substantial abutment stops.

The two cross holes for bolting this bracket to the block are bored in fixture *B*. Accurate location is important in both cases, and the same tolerances are held as in the guide holes. The production, however, is 50 per hour in this case.

Valve lifter holes have been finished in several ways, one ingenious method being to force steel balls of the proper diameter through the holes. This sized the holes with fair accuracy, but it was found that the holes could not be depended on for straightness. Any variation in the density of the metal around the hole let the ball sink into the softest place, and an erratic hole was the result. The method was clever and cheap, but though the variations were not large, they were sufficient to cause its abandonment.

The work shown is done on "Bore-Matic" machines of the Heald Machine Company.

Use of Cardboard Models in Machine Design

PAUL H. WHITE

While the use of cardboard models in machine design may be somewhat unorthodox, it gives a much clearer picture of the working of proposed mechanisms than can be otherwise obtained. In addition it saves a great deal of time.

In working out the design of a new machine, after certain conditions and limitations have been established, there are usually several possible solutions to the problems involved. As the design proceeds, variations in the remainder of the work become more and more limited. To avoid interferences it may be necessary to use an offset link; provide openings in the frame; work out a complicated system of linkages; or make certain changes in the original layout.

In order to arrive at the most practicable arrangement of the different mechanisms, the stationary parts of the machine may be drawn in their proper locations and to as large a scale as available space will permit, after which cardboard models representing the moving parts are made to the same scale. Usually the most essential thing in the preliminary layout is the location of the joints. The cardboard models, therefore, need only be flat pieces of any shape, so long as they are large enough to contain the necessary joints.

Pins or thumbtacks make satisfactory joints and permit the parts to move freely. Locations of the joints may be varied until the desired results are obtained. The outlines of the detail parts may then be worked out to give the proper strength and appearance. The entire cycle of movements may thus be represented, so that any interference can be readily detected and the effects of any changes may be noted.

Employment Stabilization

W. W. BURDEN

One of the basic concepts on which our entire business structure operates is the division of labor and specialization. No one questions the soundness of this idea as applied to the individual. Now it is becoming more and more apparent that it applies substantially to groups of individuals—to corporations.

The indiscriminate adding of functions by large corporations jeopardizes efficiency, complicates control and is very likely to aggravate an unsatisfactory employment situation.

One striking example of this is the methods largely used to handle tooling and die work in many of our large metal-working plants — especially in those plants convulsed more or less frequently by design changes in the product manufactured.

With the advent of a new model come a multitude of engineering and production problems. Because so much depends on the efficiency of a plant's tooling, the tooling for the new model becomes a major problem.

The Tooling Department is hurriedly recruited and put under tremendous pressure, for time is a most important element in the whole operation. New tools, dies and jigs must be designed, checked and constructed, with last-minute revisions in product design thrown in to complicate Tooling Department activities. The whole procedure is carried on at a tension that challenges human endurance and that is unavoidably wasteful both of time and material.

Seasonal Employment

Finally the manufacturing equipment is ready, the tooling job done and the new model put into production. Then the Tooling Department has a chance to relax until the next model is ready to be launched. But relaxation means drastic reductions in personnel. It means that most of the tool designers, draftsmen, and tool or die makers must look elsewhere for an opportunity to work. It means that many of these men are forced to accept local relief until they are again needed the following year or season.

It is not doubted that industry would voluntarily remedy the situation if the problem were studied without prejudice. It is not hard to demonstrate the lack of economy in handling the problem as outlined, in view of the large carrying cost of equipment and space, to say nothing of the cost of personnel turnover. Nor is it impossible to find competent tooling organizations who do nothing else—organizations with adequate personnel highly trained who can assume full responsibility for the entire job regardless of its size.

These organizations can do a far more effective job, can do it more economically and they hold practically all their employees throughout the year. They serve many industries with tooling programs that are taken up successively throughout the year. These organizations constitute a constructive force in our campaign for recovery.

A minimum annual wage law might aid in bringing situations like this to an impartial study by management. But like many other nostrums, the medicine may be worse than the disease.

It is a problem which should be solved by management divested of the pride and prejudices of 1929.

IDEAS

FROM • PRACTICAL • MEN

Gage for Location and Depth of a Recess

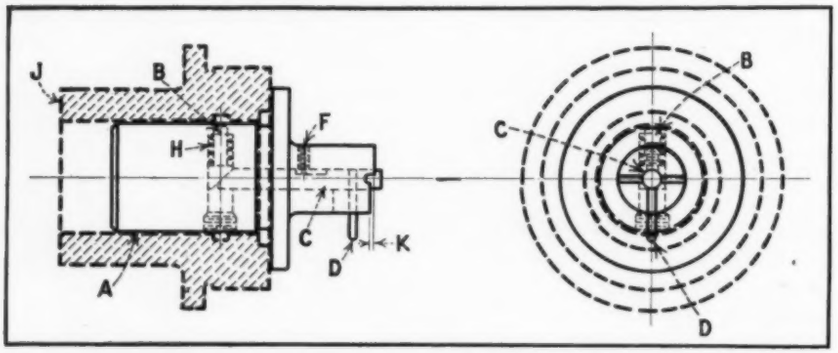
F. SERVER

The gage illustrated is for gaging both the location and the depth of an annular recess. The body *A* is a push fit in the hole in which the recess is cut and is stopped by the shoulder coming into contact with the surface of the work. The gaging pin *B* is located the correct distance from the shoulder of the body and its gaging end is the same width as that of the recess. The opposite end of the gaging pin is beveled at an angle of 45 deg. The gaging pin is operated by pin *C* the inner end of which is also beveled at an angle of 45 deg. This pin is operated by pushing the small pin *D* endwise, its movement being limited by the screw *F* engaging a slot therein. Spring *H* normally keeps the point of the gaging pin out of the recess.

In use, with the work laid on the bench and resting on surface *J*, the gage body is put into the hole. Pin *C* is pushed down by the small pin *D*, forcing the gaging outward and into the recess by the action of the angular mating surfaces on the ends of both pins. If the depth of the recess is correct within the required limits, the outer end of pin *C* will be between the steps *K* on the outer end of the gage body.

If the recess is not at the correct distance from the surface of the work, the point of the gaging pin will not enter it when pin *C* is pushed down.

While this method of gaging is not accurate within close limits, it is satisfactory where the limit allowance is 0.01 in., which is close enough for most operations of recessing.



This gage will gage both the location and the depth of an annular recess within a limit of 0.01 in., which is close enough for most work of the kind

A Problem in Laying Out Discussion

O. D. BRADSHAW
Fredericton, New Brunswick, Canada

In an article under the title given above (*AM*—Vol. 79, page 24), James Pearman discusses a problem presented by Harold E. Murphey (*AM*—Vol. 78, page 453). One disadvantage of Mr. Pearman's solution is that it is too long drawn out. Another is that no angles can be found.

I herewith present a simple solution in which the angles can be found. In the triangle *ABC* the sides *AB*, *BC* and *AC* are known. Then,

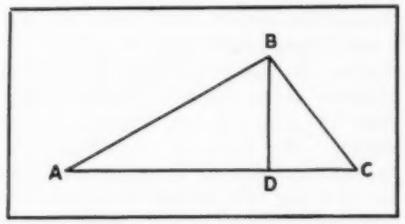
$$\cos B = \frac{AB^2 + BC^2 - AC^2}{2 \times AB \times BC}, \text{ and}$$

$$\sin C = \frac{AB \times \sin \text{ angle } B}{AC}$$

$A = 180 \text{ deg.} - (B + C)$
$DC = BC \times \cos C$, and
$BD = BC \times \sin C$

It is not necessary to find angle *A* to determine *DC* and *BD*.

If the triangle *ABC* forms a right angle at *B*, then angle *C* could be found as follows: $\sin C = \frac{BA}{AC}$.



This problem can be solved in more than one way. By the simple calculations given, the sides and angles of both triangles can be found

From the foregoing, every side and every angle in the triangles *ABC* and *BDC* can be laid out in a comparatively short time by making the simple calculations given and referring to a table of sines and cosines.

Testing Squares for Truth Discussion

JOHN S. CHAFEE

While beams and blade edges of squares are held accurately at 90 deg. with each other, sides of the blades can not be held commercially at 90 deg. with the beams. To do this would add prohibitive expense and great difficulty to the making of hardened squares.

Since the sides of the blades are not accurately square with the surface on which the beams rest, a check of a commercial bevel-edged square against a cylinder is not recommended, particularly when the cylinder is of such small diameter as shown by John E. Hyler (*AM*—Vol. 78, page 714). The edge of the blade can have a line contact only with a cylinder, and any sidewise variation in the blade breaks the contact. A good, commercial bevel-edged square having a slight sidewise bend in the blade would be rejected when tested by Mr. Hyler's device and, conversely, an incorrect blade having just enough side-wise bend might shut out the light between it and the cylinder and be accepted as being accurate.

The use of cylinders for checking squares is common and not infrequently causes the rejection of such squares as have the blades accurately at 90 deg. with the beams. The hardened square, particularly in large sizes, is a sensitive tool, and uneven temperature on either the blade or the beam will throw it out of truth in a minute or even less. Consequently, it is important that the fixture used

for testing be built on entirely correct principles in order to avoid additional and unnecessary variables.

The best simple fixture for testing squares that I have seen was designed and is in use by the Niagara Machine and Tool Works at Buffalo. It consists of a flat base more than twice the length of the beams of the squares to be tested, having an upright blade in the center. This blade is about the dimensions of that of a large square. It is pivoted in the base and can be locked by a screw. The square to be tested rests on the base and the edge of its blade is brought against the edge of the blade in the fixture, which is pivoted until its edge and the edge of the blade in the square to be tested are in contact throughout and shut out the light. The fixture blade is then locked by its screw. The square being tested is then turned 180 deg. and the edge of its blade is brought against the opposite edge of the fixture blade. If the light between the two edges is shut out, the square is accurate. Any opening between the edges of the two blades in the second position is double the error of the square.

With a testing fixture of this type, the square blade may be off sidewise a small amount without in any way disturbing the accuracy of the check. As one connected with the manufacture of hardened squares, I would earnestly recommend the use of a fixture such as that just described, as results of tests with it will be more accurate than with one having a cylinder.

An Improvised Device for Sharpening Slitting Saws

PETER L. BUDWITZ

In the illustration is shown a device designed for sharpening slitting saws in shops where not enough of them are used to warrant purchasing special equipment for the purpose. The device can be applied to any floor grinder having a suitable toolrest.

The dovetail slide *A* is guided by gibs attached to the toolrest and carries a plug to fit the hole in the saw. The saw is indexed by hand, the spring-actuated pawl *B* being forced out of engagement with the tooth spaces by the action of the backs of the teeth on the beveled edge of the pawl. As soon as the top of a tooth passes the pawl, the pawl is moved into engagement with the next tooth space by spring *C*. Adjustment for depth of cut is controlled by the stop screw *D*. A tension clamping device for holding the saw down may be added if necessary, but it should be free enough to permit the saw to be easily revolved by hand.

With the saw in place, the slide is moved toward the grinding wheel, which is dressed to the shape of the tooth spaces. The stop screw is then set for depth of cut and grinding can proceed.

Surface Grinding Thin Brass Articles

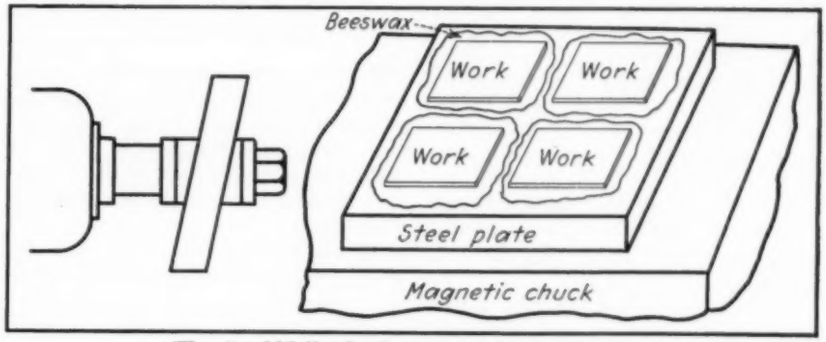
IRA S. WILLIAMS

We had some very thin brass pieces to grind flat. Due to the non-magnetic property of the work, the following method of holding it was resorted to:

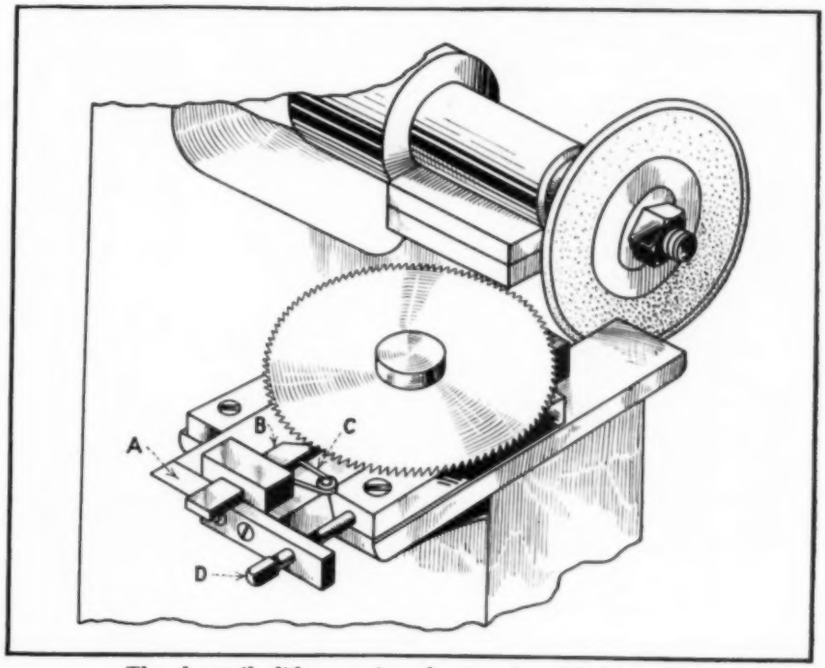
A suitable piece of cold-rolled steel was ground flat and parallel and the work was attached to it by pouring melted beeswax around it. The plate carrying the work was then mounted on the magnetic chuck of the surface grinder.

It was found that when the abrasive wheel was mounted in the conventional manner, the friction between the work and the wheel so heated the beeswax as to melt it and the work became loosened.

To overcome this difficulty the wheel was mounted at an angle using special collars, as shown in the illustration, and was then dressed in the conventional manner. When using this so-called "wabble" wheel, the cut was intermittent and this and the disturbed air caused by the runout of the wheel kept the work sufficiently cool to prevent melting the wax.



The "wabble" wheel gave an intermittent cut and did not heat the work enough to melt the beeswax by which it was attached to the plate



The dovetail slide carrying the saw is guided by gibs attached to the toolrest of the grinder. The saw is indexed by hand by the aid of a spring-actuated pawl

Jig With an Adjustable Bushing Plate

CHARLES C. TOMNEY
Chief Tool Designer
Carrier Engineering Corporation

The jig illustrated in Fig. 1 is for drilling tap holes in lugs *A* of the engine frame shown in Fig. 2 for screws for the valve-rod bracket. These holes must be central with the center line of the frame or the valve rod will bind. The round part *B* of the jig having enough surface in the guides to automatically square it with the center line, is a nice fit in the crosshead guides and is clamped in position by drawing the bushing plate against the lugs to be drilled.

Since the opening at the top of the engine frame is too small to permit the jig to be entered at that point, it is entered through one of the side openings at a point between the lower ends of the crosshead guides and the shaft bearings. As the engine frame is tapering and the faces of the lugs to be drilled are nearer the vertical center of the frame than is the outside of the frame where the jig is entered, the bushing plate must be moved outward to clear the frame. For this reason the bar *C* to which the bushing plate is attached, is slotted at *D*.

After the jig has been entered in the engine frame, its round part is pushed into the crosshead guides far enough to bring the bushings into the centers of the lugs to be drilled. The jig is then clamped by drawing the bushing plate against lugs by tightening the knurled nut *F*, after which the bar *C* is clamped by tightening the knurled nut *H*.

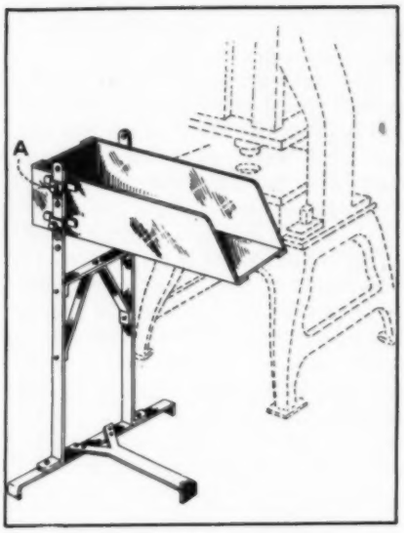
It should be noted that the engine frame is placed in a horizontal position for drilling the lugs, and that the distance from the top of the frame to the centers of the holes to be drilled is not important, so long as the holes are about in the centers of the lugs. After one hole has been drilled, a plug is inserted through the bushing into the drilled hole to prevent the jig from shifting while the other hole is being drilled.

Adjustable Work Chute for Press Operators

CHARLES H. WILLEY

Handiness of the flow of parts, where hand feed must be used for presses, is an important factor in costs. The work chute illustrated has proved to be of real value, so that several of them have been made and are in use in our press-room.

The material used for the chute itself is ⅛-in. cold-rolled sheet steel. The braces and the legs are made from ¼ x 2-in. flat iron. The chute proper can be adjusted for height by loosening the handscrew *A* at the side.



Where parts must be fed by hand for second operations, chutes of this type are a great convenience to press operators

Puller for Bearing Shells Discussion

NORMAN C. IRVINE

In his discussion of my article under the title given above, J. T. Towlson (*AM*—Vol. 78, page 808) says he would like to know how my device functions.

It is obvious from the illustration of the device that the fingers (frictionally held) are opened through the end of the motor housing. Then the binding washer and the nut are put in place and the nut is tightened.

The size of the device enables bearings having bores from 2¼ to 4¼ in. to be removed quickly and easily. Two larger size binding washers are used for the larger bores to support the fingers, which at all sizes are square against the end of the bearing. Thus babbitt-lined bearings can be removed and replaced without indenting the babbitt.

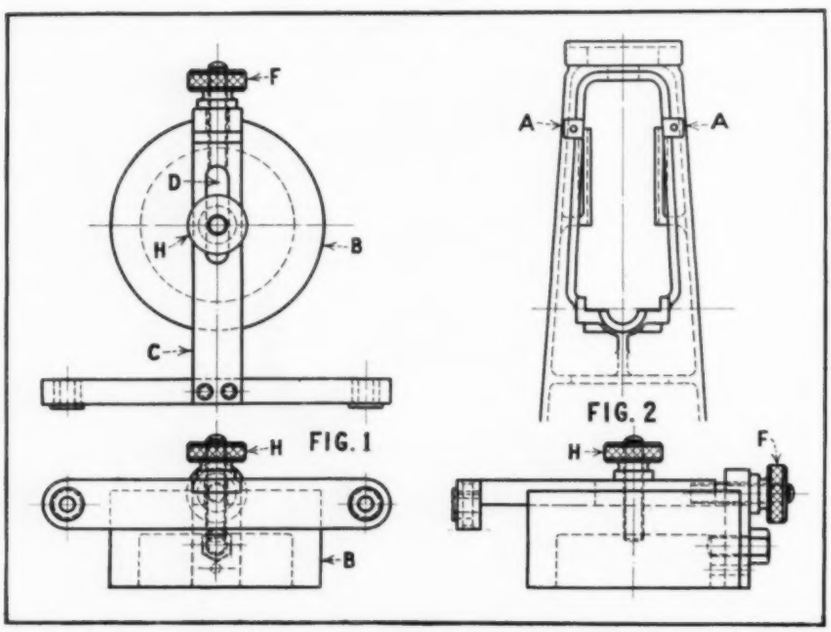
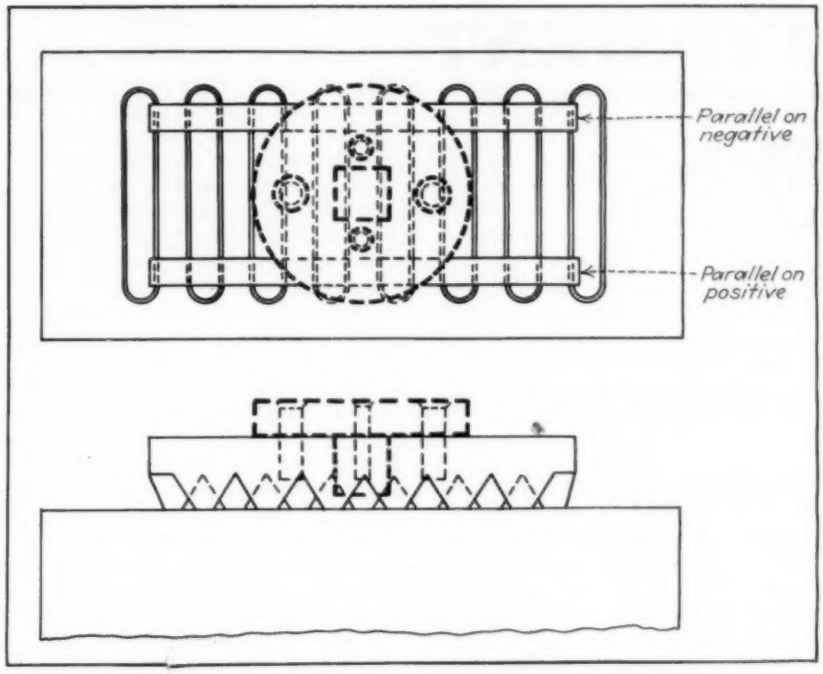


Fig. 1—The bushing plate is adjustable to clear the engine frame at the point of entrance of the jig. It also serves as a clamp to hold the jig in position. Fig. 2—The engine frame showing the lugs to be drilled.

Parallels for Use on Magnetic Chucks

PETER YUNICK

Ordinarily parallels will not hold work on a magnetic chuck because they will be in contact with both magnetic poles of the circuit and will not permit the magnetic current to flow. To bring them into contact with opposite poles they should be cut away at the bottoms, as shown on next page.



Parallels notched at the bottom, as shown, will each be in contact with opposite magnetic poles, permitting magnetic flow from one *to* the other and magnetizing the work

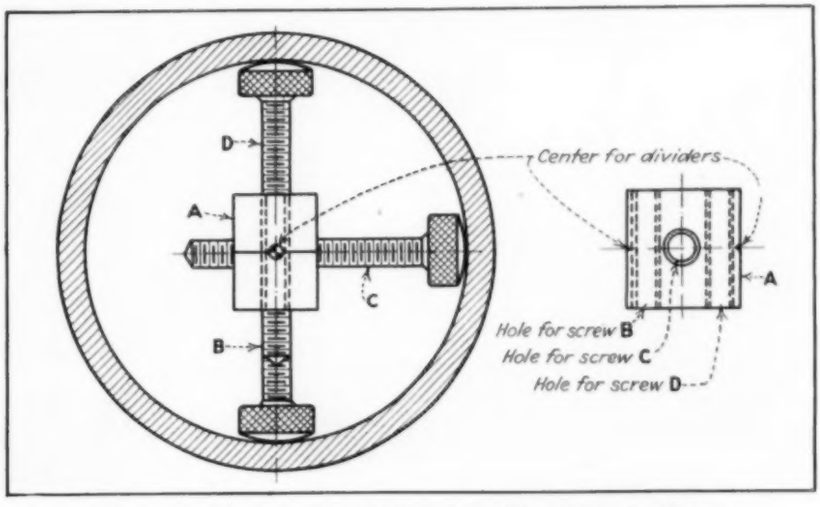
While the cuts may be of any desired shape, they must be so spaced that when the ends of the parallels are flush, the flats on the bottom of each will be in contact with opposite poles. Thus the magnetic flow will pass from one parallel to the other, holding the work securely.

A Centering Spider

WILLIAM M. HALLIDAY
Baildon, Yorkshire, England

It is often necessary to scribe arcs from the centers of holes for locating other points. The usual method is to fit a piece of wood crosswise of the hole and to use it as a base for the divider point, after the center of the hole has been found by trial and error. The use of such a center is attended with some disadvantages, chiefly being caused by loosening of the wood insert by pressure of the divider point and throwing the center point out.

By the use of the spider illustrated, the operation of finding the center of the hole is made easy. The block *A* has centers for the divider point on two opposite sides and is drilled and tapped for the three adjusting screws *B*, *C* and *D*, each hole being in a different plane so that no one screw will interfere with either of the others. The advantages of this device are that it can be quickly adjusted to bring the center for the divider point in the center of the hole; that it can be used in holes varying greatly in diameter.



The central block can be easily and quickly adjusted to bring the center for the divider point in the center of the hole

Fastening Drawing Paper

BERT WALLACE

A better way than using thumb tacks for attaching paper to the drawing board is to use a Bostich stapler. The lower part, or curling die, is removed, permitting the two prongs of the staples to be driven straight into the board. They make smaller holes and hold the paper more securely than do thumb tacks, and are very easily removed.

Flexible Shaft Serves as a Coupling

MALCOLM K. PARKHURST

It may not be generally known that one of the simplest and most effective kinds of flexible couplings can be made from the type of compound coil winding as contained in flexible shafts. The casing is removed and a piece of the necessary length cut off (an abrasive cutoff wheel or grinding wheel is best for this purpose) and soldered in the holders as shown. This type of coupling is quite noiseless and allows of a wide misalignment of the two shafts without affecting the drive.

This flexible-shaft coupling connects a motor and blower

SHOP EQUIPMENT NEWS

Carlton Light-Duty Radial Drill

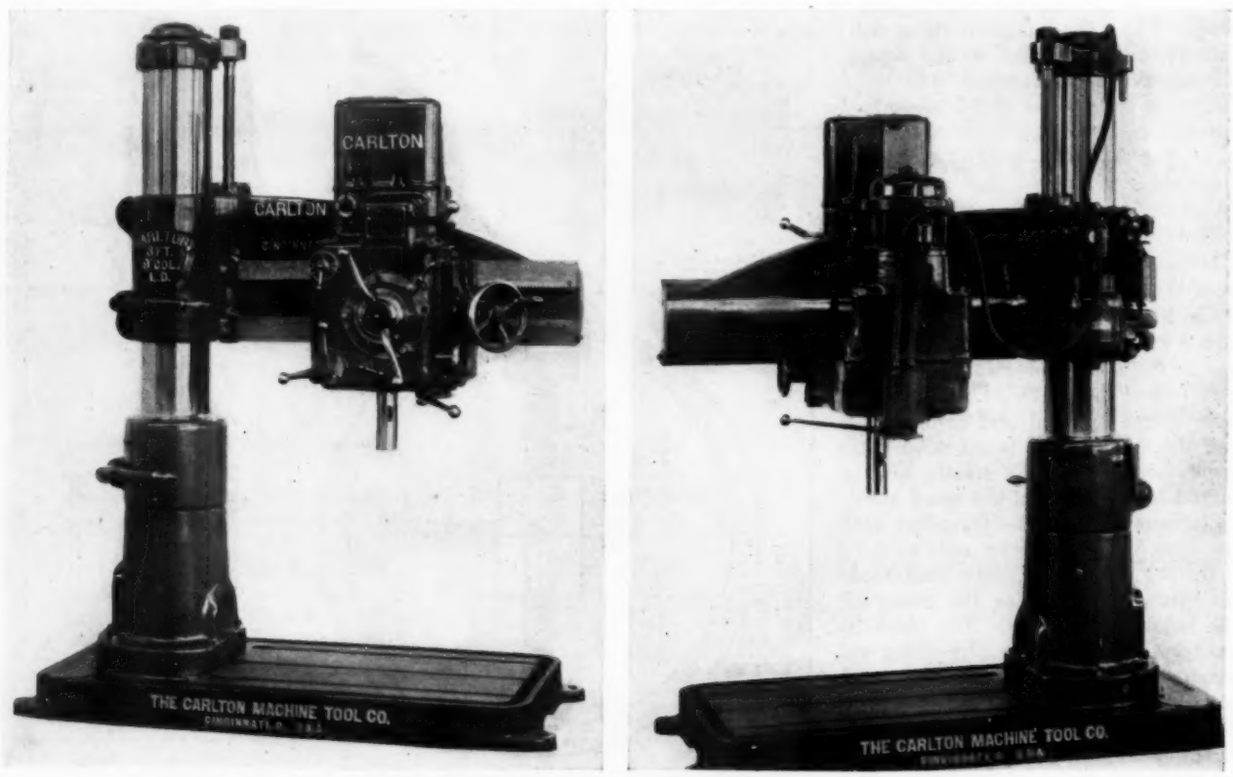
The Carlton Machine Tool Co., Cincinnati, Ohio, has added a light-duty model to its line of radial drilling machines. This machine has a 9-in. column and is made in 3- and 4-ft. arm sizes. The design is almost identical with the original Carlton line of low-hung driven radials, with the exception that a reversible motor is mounted directly on the transmission, at the rear of the head. It drives down under the arm, on the largest diameter of the spindle. There are nine speed changes, covering a range of 75 to 1,500, 100 to 2,000, or 150 to 3,000 r.p.m. Four feed changes are available, from 0.006 to 0.020 in. per revolution of the spindle. A small reversible motor, which is operated by a single lever, raises, lowers and locks the arm around the column. Automatic stops control the maximum travel of the arm. A clutch on a stationary screw acts as a safety device for stopping the travel of the arm should it meet an obstruction. The spindle also has automatic stops controlling its maximum travel, and a depth dial can be set to automatically stop the feed at a predetermined depth.

"ZAM" Anodes

The Hanson - VanWinkle - Munning Co., Mattawan, N. J., announces the development of an anode named "ZAM" (zinc, aluminum, mercury). This anode is not attacked by either acid or cyanide solutions until the current is applied, making it possible to have an anode free from sludge, and one which can be completely used in zinc solutions. No sludge on the anodes means no anode polarization. Therefore, practically no increase of voltage will be required at any time.

When ordinary zinc is used, a higher voltage is necessary to obtain the required current density as the anode coats over with decomposed zinc. The higher pressure results in more hydrogen being included in the deposits and, therefore, heavy deposits become brittle and non-adherent. On wire or BX cable, for instance, with ordinary zinc anodes in the solution commonly used, a deposit that will withstand more than two Preece tests is difficult to obtain. With Zam anodes, a deposit can be obtained that will withstand six tests.

Cyanide zinc solutions can be obtained at a fairly constant metal content by the anodes. This is made possible by the use of steel containers and ball anodes.

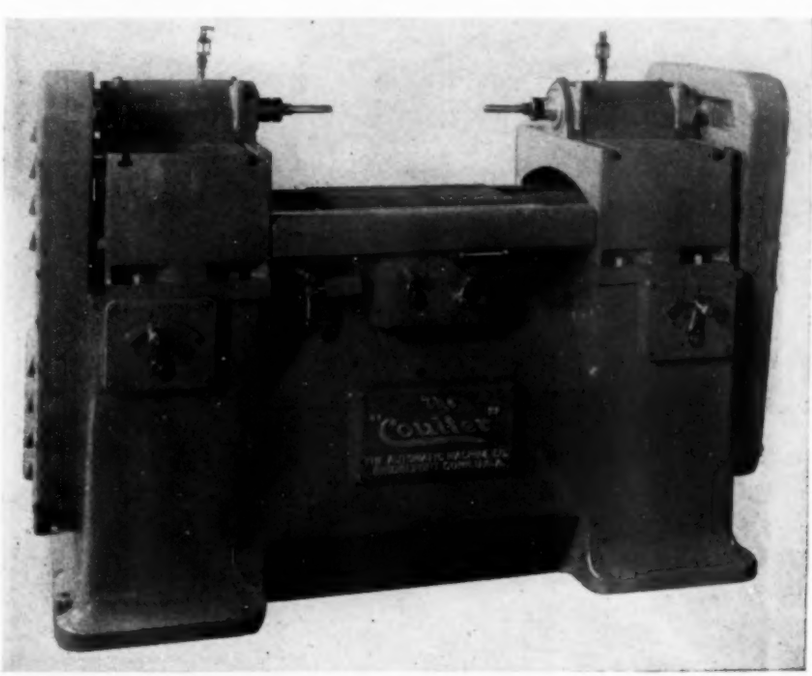


This radial drill needs to be oiled only once every six months. Rear view of the machine shows the motor mountings, which eliminate all horizontal shafts

Coulter Type "C" Hydraulic Horizontal Precision Boring Machine

The Coulter Type C boring machine, introduced by the Automatic Machine Co., Bridgeport, Conn., is intended for boring precision holes in all kinds of material and in unlimited variety of sizes or shapes. Table feed and revolving of the spindles are accomplished from one hydraulic unit. All controls and adjustments are on the front of the machine. The cycle of the table is completely automatic and can be altered for length of stroke, rapid advance and traverse, and also for length of feed stroke for either end. Holes of different lengths can be bored on both ends without loss of time, and the desired length of rapid traverse can be set to take care of any position between the boring spindles. Rate of feed and speed for each end can be positively set from the dials on the main feed panel to take care of difference in diameter or quality of finish required, each end independent of the other. Spindle speeds are controlled on the front panel by a handle on either end of the machine for the desired speed. The hydraulic motor on either end is adjustable up and down to take care of belt stretch and variation in belt length when changing from one to two spindles or vice versa. Hydraulic motor drive to the spindles eliminates clutches, brakes and drive shafts that must be kept in adjustment for wear and in cycle with the rest of the machine. With this hydraulic drive, an infinite number of speed changes from 200 to 2,000 r.p.m., or from 400 to 4,000 r.p.m., are available. Spindles may be stopped upon the completion of the first pass through the holes so it will not cut a return spiral when withdrawing from the hole, or the spindle can continue running and feed on the return stroke and stop at the completion of the hole.

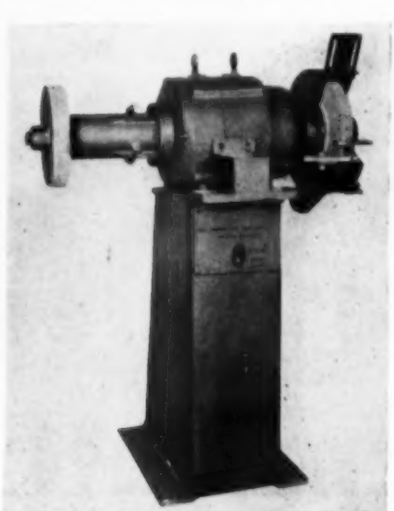
When using a coolant for cutting tool, the movement of the table automatically turns it on and off at the proper time, so the operator has a clear view of his fixtures for loading. The coolant tank in the base of the machine has a capacity of 5 gal., and coolant is filtered on its return from the table. The table cycle is as follows: rapid traverse from one side to the other, slowing down to the desired feed for length of travel as desired, then rapid traverse to the opposite side where the cycle is again repeated on the other end. Any other cycle can be accomplished by adding and changing feed controls on the table which engage plungers on the main control panel. A 20-gal. tank for oil used in the hydraulic system is directly over the pumps in base, thereby keeping the pumps constantly primed, eliminating air binding of the hydraulic system if machine is left idle for some length of time. The boring spindles are mounted on special ball bearings for diamond boring and the spindle heads are adjustable for center-to-center distance on the bridge, which can accommodate one to three spindles. All moving parts are totally inclosed and the only points needing manual lubrication are the boring spindles and electric motor. The weight of the machine is 7,000 lb., and the floor space required is 68x30 in.



The electric motor and pumps are mounted on one floating plate in the base and are accessible through a large opening in the rear of the machine

Production Type 885 Grinder and Buffer

The Production Equipment Co., 5219 Windsor Ave., Cleveland, Ohio, has placed on the market a Type 885 combination machine that consists of a three-bearing grinder and buffer. The standard assembly places the buffer on the left, using a two-bearing inclosing housing with one bearing located close to the buffing wheel. The spindle is of alloy steel with safety-type threads and flanges for both wheels. The grinding end has a welded-steel guard with exhaust connection, hinged end cover, and adjustable toolrests. Safety-glass eye shields are furnished as an extra. All ratings above 1 hp. are supplied with a push-button starter having no-voltage and overload protection. Motors are of the totally inclosed, ball-bearing construction. The grinder and buffer combination machine is built for both normal and heavy duty.



Hanchett No. 72 Rotary Surface Grinder

The No. 72 rotary surface grinder, manufactured by the Hanchett Manufacturing Co., Big Rapids, Mich., is of special construction and fitted with automatic means for loading, clamping the work, grinding, and unloading finish ground parts. It is being used in a large automobile plant. The machine comprises a bed carrying a circular work table 72 in. in diameter by 18 in. wide, which is driven through a variable-speed unit, giving the table an infinite number of speeds ranging from ¾ to 4 r.p.m.

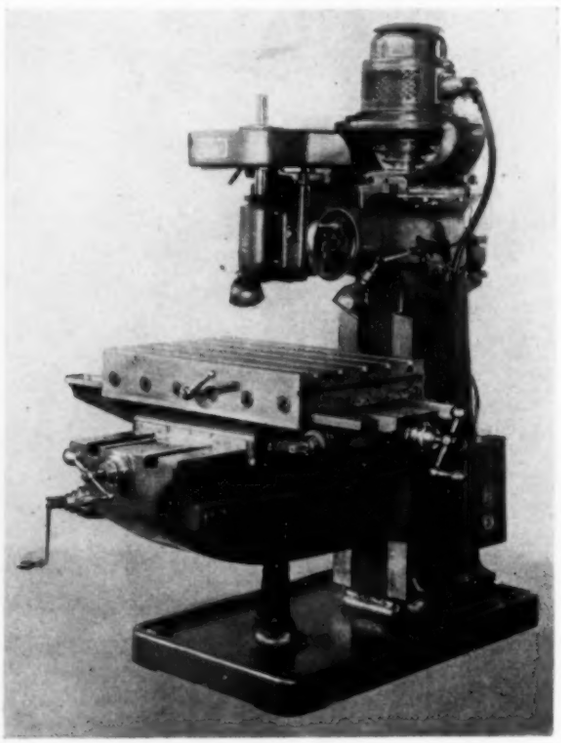
The work to be ground passes successively beneath the three grinding wheels, each of which is provided with automatic sizing control which compensates for wheel wear and gages the size of the work. The first grinding wheel is of No. 20 grain, the second No. 46, and the third No. 120. This combines an assortment of wheels selected for large stock removal and at the same time produces a piece with a fine and accurate finish.

Parts to be ground are of cylindrical shape, measuring 1 in. O.D. by 1¾ in. long. It is required to grind both ends of these pieces parallel to within 0.001 in., and square within 0.0004 in. runout. Stock removal is approximately 0.040 in. per end. When the pieces come to this grinder, they have previously been through a Cincinnati centerless grinder, bringing them down to within 0.001 in. of finished outside diameter size. The ends are still in the rough. These parts are shoveled into the Danly hopper feed. By means of this device they are fed upwardly through the loader tube, passing into the automatic loader which is the swinging arm device. The fixture which receives these parts is mounted directly on the finished table top and comprises 84 stations, each of which has automatic clamping means. Pieces are fed into each station while in motion, and after passing beneath the three grinding wheels and making nearly one complete revolution, they reach the first ejector mechanism. A piece is ejected upwardly through a tube and passes across into the second loader at the right. This second loading device places the piece, which has been ground on one end, into a clamping station with the opposite end up and ready for grinding. After one more circuit, this same piece reaches the second ejector mechanism, where it is conveyed through a tube into a suitable container.

Reed-Prentice 3VS Vertical Milling and Die-Sinking Machine

The 3VS vertical milling and die-sinking machine, manufactured by the Reed-Prentice Corp., Worcester, Mass., is designed especially for rubber mold and metal pattern work. It is equipped for hand longitudinal and cross feeds. Table and saddle are mounted on roller bearings carried in eccentric holders for adjustment, and operating on hardened steel ways of the knee and saddle, dowelled in place. Lubrication of the rollers is by the Alemite system. A special square nut on the spindle provides for locking it when removing collets and cutters. Ends of the table are slotted for clamping extra long plates. Underside of the throat is cut out for a lamp in addition to the bracket lamp shown. Longitudinal and cross feed screws are provided with adjustable nuts. Like the standard 3V machine, pushbutton control with magnetic

Three vertical grinding wheel-heads, supported by a center column, carry 20 in. cylindrical wheels, each driven by a 25-hp. motor



The spindle of the Reed-Prentice machine is locked when collets and cutters are removed

switch and plugging relay provides for quick stop of the spindle.

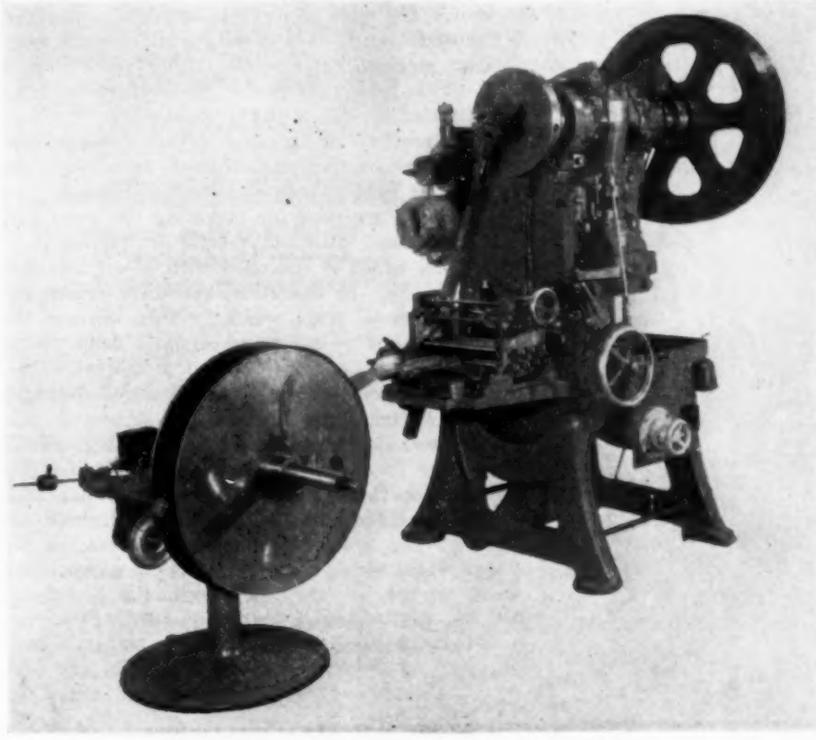
Specifications: Longitudinal feed, 27 in.; cross feed, 20 in.; vertical feed of knee, 16 in.; 10 spindle speeds with 1,200-r.p.m. motor, 400-2,600 r.p.m.; table dimensions, 32x22x4 in.; vertical adjustment, 5 in.; throat depth, 22 in.; maximum distance, spindle to table, 16½ in.

Littell Automatic Punch Press Reel and Roll Feed

A No. 0 reel with automatic brake, designed to hold coils of stock weighing up to 100 lb., has just been put on the market by the F. J. Littell Machine Co., 4127 Ravenswood Ave., Chicago, Ill. This reel is mounted on needle bearings, and the automatic brake prevents the stock from unwinding too rapidly. When the stock is pulled forward the roller raises, releasing the automatic brake so that the stock can be pulled without any resistance from the reel. As soon as sufficient stock has been unwound, the spring pulls down the roller and throws on the brake. When fitted with arms, the No. 0 reel will handle coils 9 in. inside diameter, 32 in. outside diameter, 3½ in. wide.

The company has also developed a roll feed that handles stock up to 16 in. wide and feeds up to 36 in. per stroke of press, at a speed of 92 strokes per min. The stock is fed directly from a power-driven reel which unwinds a loop of stock, and thus avoids the necessity of the roll feed pulling the stock directly from the coil, as it pulls from the loop only. The feed is equipped with an automatic roll release which allows the operator to place the stock in the die just at the point where it is to be blanked, and the first half feed of the roll is killed so that the die blanks at exactly the point where the stock is placed without first moving ahead to waste a half a blank.

When fitted with plates, this No. 0 reel takes coils 1¾ in. inside diameter, 32 in., outside diameter and 3½ in. wide

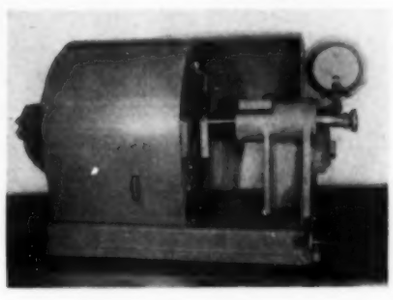


This press is driven by a U. S. Varidrive Motor with a speed range of 50 to 150 r.p.m., controlled by hydraulic remote control

Carpenter 50,000 Ft.-Lb. Torsion Impact Testing Machine

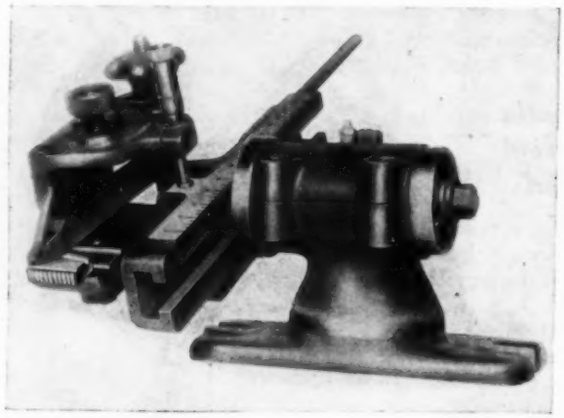
In order more nearly to simulate service conditions, the Baldwin-Southwark Corp., Philadelphia, Pa., has built a torsion impact testing machine having a stored energy content of 100 times that of any such machine previously built. This machine has available at 1,000 r.p.m., 50,000 ft.-lb. of energy, sufficient to test any known steel specimen in diameters up to 1 in., and many steels up to 1¼ to 1⅜ in. in diameter.

The actual operation of making a test is essentially as follows: The test specimen is clamped in the head and the cross-arm attached. The handle is pushed entirely to the right so that the cross-arm clears the striking bosses. The momentum unit is then rotated by power from a small motor through friction drive controlled by the handle. When a predetermined speed, as indicated by the tachometer, is attained, the handle at the right is pulled sharply toward the left, bringing the cross-arm into engagement with the bosses on the rotating wheel, and the specimen is thus broken under torsion impact. The residual speed of the wheel is then read, and since the kinetic energy corresponding to various wheel speeds has been previously calculated from the moments of inertia of the moving parts, the energy absorbed in foot-pounds in breaking the specimen can be obtained from a prepared table.

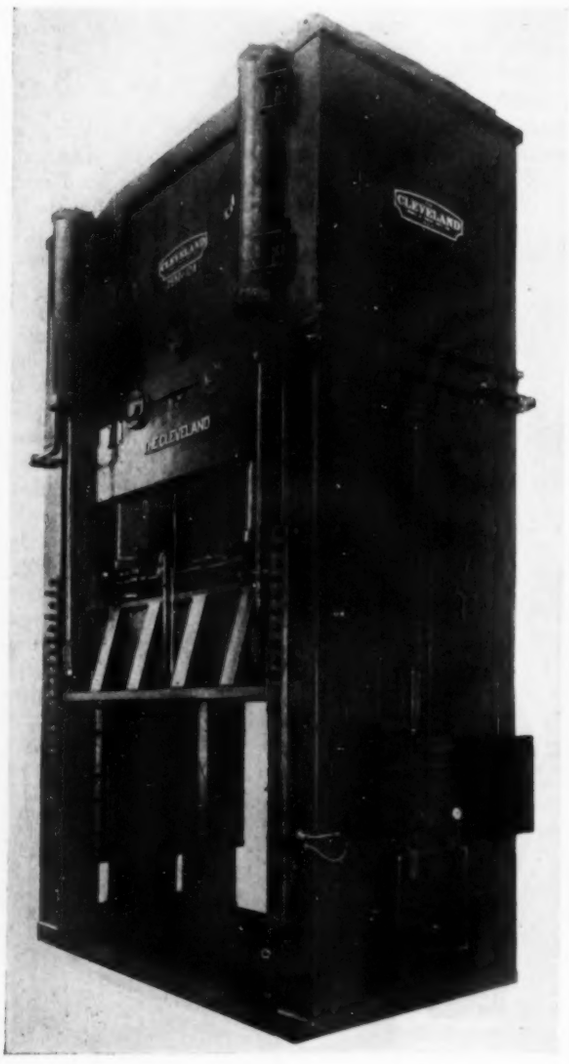


Landis Tap-Chaser Throat Grinding Attachment

The Landis Machine Co., Waynesboro, Pa., has placed on the market a tap-chaser throat grinding attachment for use in regrinding the throat or chamfer on Landis collapsible tap chasers. The base of the attachment is arranged for bolting to the table of most standard makes of tool and cutter grinders. Attached to the base is a swivel base which carries the spindle to which is attached the vise base for holding the chasers. The vise base is adjustable for setting the chasers on a radius corresponding with that of the thread which they are to cut. It is graduated for diameters from 1 to 13½ in., and is fitted with a micrometer for obtaining the desired amount of radial clearance with which the chasers should be ground. A milled flat which will accommodate all sizes of tap chasers manufactured by the Landis Machine Co. is provided on the vise base. Individual chasers are held by an adjustable clamp and locked with a hand screw. The base rotates with the spindle, which is fitted in a capped bearing, to provide an oscillating movement for grinding the chaser against the face of a cupped wheel. To facilitate this movement a handle is fitted to the vise base. This motion will produce a radial clearance on the chaser throat. This attachment permits the grinding of the throat on all chasers in a set to the same degree and length.



The attachment is suitable for grinding chasers used in Landis Styles LT and LM Taps, as well as the Victor collapsible taps up to 12 in.



Cleveland Welded Steel Press

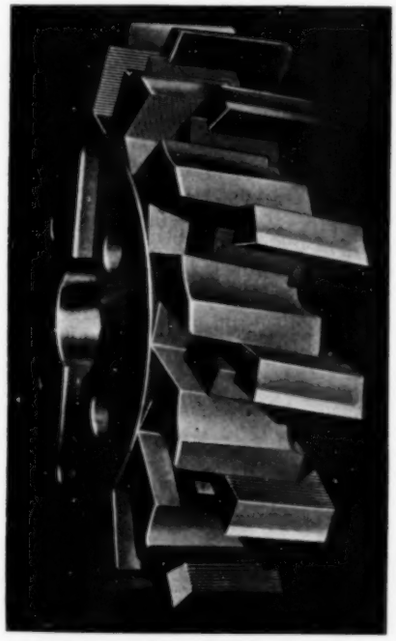
The use of welded-steel construction in building power presses by the Cleveland Punch & Shear Works Co., Cleveland, Ohio, is illustrated by one of its largest size forming presses which is used for body panels. The press weighs approximately 225,000 lb. and is 30 ft. high, having a capacity of 500 tons pressure at the beginning of the draw. It is of the four-point suspension type which prevents tilting of the slide. The slide is provided with four adjusting screws of the barrel type. These screws are connected by an interlocking gear system whereby their functioning is coordinated. This power adjusting mechanism is controlled and operated by one of the three push buttons, and is designed to prevent the operation of the press at the wrong time. Adjustment cannot be made nor the press operated until the locking motor is set. The other two push-button controls are used for operating the press and for adjusting the ram. Multiple V-belts are employed to drive the flywheel which is equipped with a multiple-disk air clutch and brake. In operation, the drive pinion engages two intermediate gears which in turn operate the four main shafts, thus providing a balanced drive to all four points of the slide.

The housings are constructed of standard rolled shapes and flat plates electrically welded, and the press is provided with six steel tie-rods, three in each housing, shrunk into place. Four long gibs designed with stiffening ribs serve as guides for the ram. Ample provision has been made for accurate adjustment by means of bolts and adjusting screws. The press has a speed of 8 strokes per min. and is provided with a 30-hp. high-torque motor. The bed meaures 80x124 in., the opening in the bed being 60x118 in. The ram measures 80x116 in., stroke 24 in., adjustment 32 in. and maximum die height is 56 in.

The driving gears are lubricated by a force-feed system which sprays oil on the gears. The oil is returned by gravity to a tank in one of the housings

Ingersoll Zee Lock Milling Cutters

The "Zee Lock" cutter blade, developed by the Ingersoll Milling Machine Co., Rockford, Ill., is securely retained in the cutter housing by a zee-shaped wedge. The wedge hooks the front of the cutter body and the back of the blade. It is impossible for the blade to shift backwards away from the cut. The back hook of the wedge is on a slant so that when the cutter blade is re-inserted and moved out a serration, it moves forward a slight amount compensating for the face wear. The main adjustment is radially, which is in the direction of



The cutter body is of forged and heat-treated chrome-molybdenum alloy steel

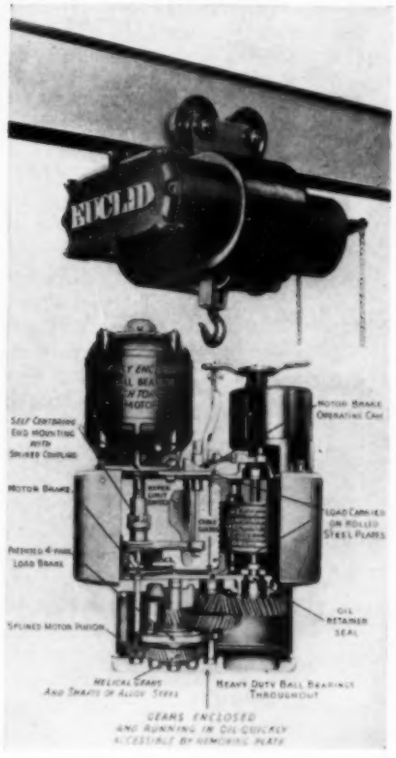
main wear. The wedge is the locking member and is not disturbed by the thrust of the cut as this is absorbed by the serrations.

This cutter blade is designed to apply to many kinds of cutting tools. Medium duty cutters, using a blade ⅜-in. thick, with a blade spacing of about 1 in., are used for medium duty or finishing operations. A heavy duty cutter, with a blade spacing of 1½ to 1¾ in., using blades ½ in. thick, suffices for a general-purpose cutter. For the heaviest of milling operations, an extra-heavy-duty cutter, with blades ¾ in. thick, spaced about 3 in. apart, is offered. Cutter bodies are made with the National Standard planer or flange nose drive, or to fit any milling machine or horizontal boring mill. Ingersoll face mills are furnished with the Zee Lock cutter blade of special selected, forged, high-speed steel, super-cobalt high speed steel, J-Metal Stellite, or tipped with cemented carbide.

Euclid Helical Gear Electric Hoist

The helical gears in the hoist announced by the Euclid-Armington Corp., Euclid, Ohio, provide a drive that is quiet and smooth in operation. Two teeth are always in mesh, eliminating the shock loads to the teeth. The frame of the hoist is of rolled steel. This construction is lighter, yet stronger than cast iron. Other features include the following: Gears and shafts are alloy steel, heat-treated and ground, shafts rotate on heavy-duty ball bearings, gears are totally inclosed and run in oil, bearings are splash lubricated and shafts have oil retainers.

A patented load brake assures safety. It contains four pawls, two diametrically opposite being always engaged. No adjustment is required. A disk brake stops the motor positively. It is operated by a cam from the controller on rope controlled types and by a solenoid or pushbutton on remote control installations. The cable drum is heavily ribbed to withstand crushing stress. It will take the entire cable in machined grooves without overlapping.


EUCLID
MOTOR BRAKE OPERATING CAM
MOTOR BRAKE
LOAD CARRIED ON ROLLED STEEL PLATES
OIL RETAINER SEAL
HELICAL GEARS AND SHAFTS OF ALLOY STEEL
HEAVY DUTY BALL BEARINGS THROUGHOUT
GEARS ENCLOSED AND RUNNING IN OIL CONSTANTLY

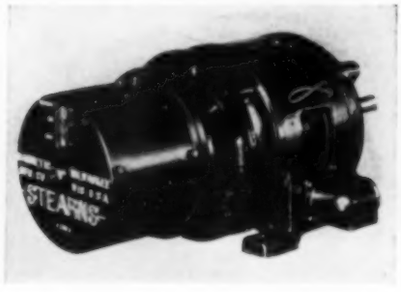
Barrett-Cravens Multiple Lift Truck

Each stroke of the handle of the multiple lift truck put out by the Barrett-Cravens Co., 3255 West 30th St., Chicago, Ill., requires the same effort. Loads can be lifted with eight short strokes or four full strokes. The handle is automatically disengaged upon release of the holding latch, and cannot fly back when releasing the

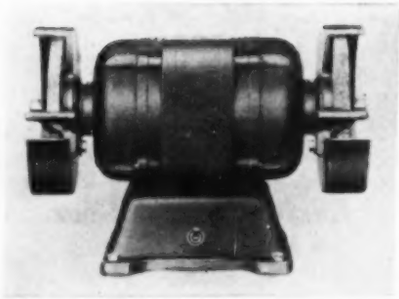
load. Ball bearings are used for easy rolling and to take care of side thrust when turning corners. The "S" model is 18 in. wide and takes platforms from 36x48 in. to 36x72 in. The "SK" model is 25 in. wide, and takes platforms from 48x54 in. to 48x84 in.

"Stearns" High-Duty Style "DS" Disk Brake

The "Stearns" high-duty Style "DS" disk brake, manufactured by the Magnetic Manufacturing Co., Milwaukee, Wis., can be made for floor or motor mounting, and can be supplied for either a.c. or d.c. Five sizes are now in production, ranging from 10 to 90 ft.-lb. torque, for continuous operation. Features include: manual release, lining wear indicator, constant torque



provided at all times and not subject to variation from lining wear, simple adjustment for torque and lining wear, and easy replacement of linings when necessary. The brakes can be furnished with or without adapter for motor mounting.

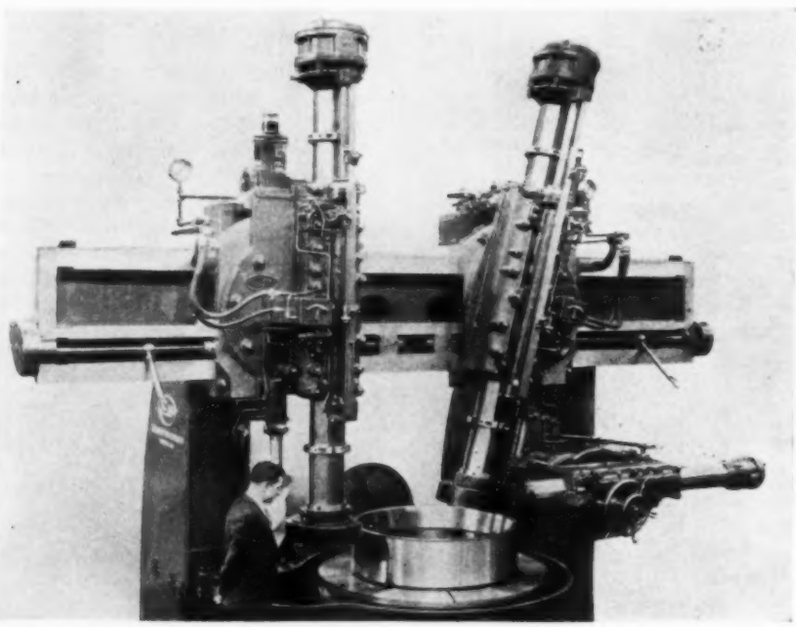


Skilsaw Bench and Pedestal Grinders

A line of bench and pedestal grinders and combination grinder-buffers, both bench and pedestal types, has been added by Skilsaw, Inc., 3310 Elston Ave., Chicago. Motors in the bench grinders range from ½-hp., split-phase type or condenser type in the 6-in. size, to 1½-hp., 220 volts, 3-phase type in the 10-in. size. Motor design and construction of the line of combination grinder-buffers are identical to the bench grinder, excepting that motors in these units are all condenser type. Guards on the larger models are the inclosed type. The toolrest and guard can be removed for buffing work. The unit is equipped with a switch in the base, 10 ft. of cord and plug, one coarse and one fine grinding wheel.

Niles Vertical Grinder

The vertical grinder recently installed in the plant of the Timken Roller Bearing Co., Canton, Ohio, is said to be the largest of its kind ever built. This machine, built by the Niles Tool Works Co., Hamilton, Ohio, weighs 105,000 lb. and stands 18 ft. 6 in. above the floor level. It is designed to grind the large cups and cones used in heavy-duty Timken bearings to a new degree of accuracy considering their size. A test run on a bearing cup having an outside diameter of 47 in. showed a run-out of only 0.00025 in. The machine is set up to grind units up to 65 in. outside diameter and 36 in. high. It carries a magnetic chuck 66 in. in diameter, driven by a 5-hp. variable-speed motor. Two vertical spindles approximately 12 ft. long, each driven by a 25-hp. motor at 1,200 r.p.m. and one horizontal spindle driven by a 5-hp. motor, at 1,800 r.p.m. enable the three surfaces to be ground at one setting. Included angles up to 60 deg. are within the range of the machine. Ten motors are required in the operation of the unit. The two vertical spindles are reciprocated by means of a hydraulic system.



• TRADE • PUBLICATIONS

GEAR FINISHER. A folder put out by The National Tool Co., Cleveland, Ohio, anounces its "Burni-Shave" gear finisher which combines burnishing and shaving operations in the finishing of transmission gears.

LATHES. The Monarch Machine Tool Co., Sidney, Ohio, has compiled a 55-page booklet presenting "Features of Monarch Lathes." The booklet is well illustrated, showing in detail all features of construction. Tools and attachments for various applications are also described, and specifications are given for the different models.

MOTOR CONTROLLERS. The Monitor Controller Co., Baltimore, Md., has compiled a loose-leaf catalog containing 66 specification bulletins. General description and characteristic features are given for over 100 types of controllers. Tables give ampere ratings of a.c. and d.c. motors at full loads, conduit sizes for wires and cables, conduit dimensions, allowable current carrying capacities of solid and standard wires.

PLATING BARREL. The Udylite Co., 1651 E. Grand Blvd., Detroit, Mich., has published a four-page circular describing and illustrating the various important assemblies of its plating barrel.

POWER PRESSES. Bulletin No. 63-B, compiled by the Niagara Machine & Tool Works, Buffalo, N. Y., presents its line of single crank power presses, series No. 50. Specifications are tabulated for 14 models.

PNEUMATIC CRANES. The Curtis Pneumatic Machinery Co., St. Louis, Mo., has issued a bulletin, known as C-27, presenting the advantages of air powered cranes and hoists, for light and medium capacity work.

SPEED REDUCERS. A booklet published by the Sier-Bath Gear Corp., 640 West 58th St., New York, N. Y., shows principles of construction, efficiency charts, and specification tables for its speed reducers. The reducers described have ratios ranging from 4 to 1 up to 120 to 1.

THREADING AND TAPPING. The Landis Machine Co., Waynesboro, Pa., has issued the fifth edition of a handbook on its threading and tapping equipment. The instructions contained therein include the grinding of chasers, the operation of threading heads and machines, grinding of tap chasers and the operation of collapsible taps.

THE ROUND TABLE

What Is Productive Labor?

"Ed, we've got to think of getting a larger staff—if that's what you call it. Business has kept increasing in spite of hard times, and I'm getting swamped with a lot of details."

"Want to add more overhead, eh, Al? I thought you were dead set against increasing overhead."

"Of course I am, Ed, on general principles. But when it gets so I can't get time to do a bit of planning, or scheme out new ways to do work in the shop, it's a case of saving money for the firm by hiring another man."

"Don't think I want to overwork you, Al, but I do hate to see another name go on the non-productive payroll. I like to see them go on the shop list where they make things we can sell."

"I know how you feel, Ed. But I think we all get a cock-eyed slant about overhead. We call the designer non-productive and class him as overhead. Yet that one change Bill Jones made in that compressor design saved us more money than any fixture you or I could have designed for the shop."

"That sounds all right, Al, but it costs money no matter what you call it. The more it costs us for men in the office the more the shop men have to produce to keep us out of the red."

"Still harping on the same string, I see, Ed. I've been trying to make you understand that some of the so-called 'overheads' are actual producers. Bill Jones is just as much a producer as though he actually worked on the metal in the shop. If you didn't help produce in your shop you'd be out of a job. Williams won't keep even you just for an ornament."

"You've sort of got me groggy, Al. All I've heard for years is that only shop men actually produced the things we sell. The rest of us are sort of policemen who keep the men at work and settle squabbles of one sort or another. Kind of a necessary evil if you will, but still costing real money that is to be saved if possible."

"A lot of people have that same slant, Ed, but I think they're wrong in not sorting out the *kinds* of overhead. If any of us help production, even if only by preventing soldiering, or blocking mistakes, we belong on the list of useful citizens. The cop, or politician, who gets a bit of protection graft from any kind of business, is wasteful overhead. I want to hire a man who will help me produce more by relieving me of details that can be handled by a cheaper man."

"It still looks to me like adding to the overhead, Al."

What is overhead? Can any of it be classed as productive labor? Or should all executives be classed as non-productive?

Discussion

Tap Testing

An ingenious elimination of the accumulated-error proposition is what Al has discovered and put into use. More power to him and more power to his lower jaw until Ed realizes that his argument hasn't a leg to stand upon. Al said a mouthful when he stated that all fine measuring instruments referred to by Ed have their places and are indispensable. It is one thing to know when and how to use them and quite another to know when not to use them.

Some matters of accuracy are absolute, others are strictly relative. It matters little if the tapped holes are a little too large or a little too small, providing the screws are correspondingly large or small. By the measuring process, even if we grant that all the screws are uniform and all the tapped holes are uniformly produced with carefully measured taps, there is always the chance that an error, however infinitesimal, may be in the plus direction in one and in the minus direction in the other. In such a case, the relative or accumulated error will be equal to the sum of the two errors.

Seeming crudity of method may often be resorted to as a means of avoiding trouble or of gaining some advantage. In many cases the trouble avoided or the advantage gained will be more or less obscure, but it will be none the less real. The tap testing proposition is but one of the many cases. —JOHN E. HYLER.

If Al wishes to obtain correctly tapped holes let him first try good taps from a reputable maker and use them properly. Initially, it may be necessary to test the taps, but the practice involves interruption of the work flow, hence it should be curtailed to the limit.

The general run of work demands accuracy of lead, rather than avoidance of oversize or undersize diameters, and lead is pretty well under control when ground taps are used. After production-test determination of the pitch diameters of taps required to produce satisfactory holes, taps may be purchased to dimensional and material specifications as required. When productively used under conditions duplicating those of the test, reasonably uniform work can be expected of such tools.

Where design and processing, sepa-

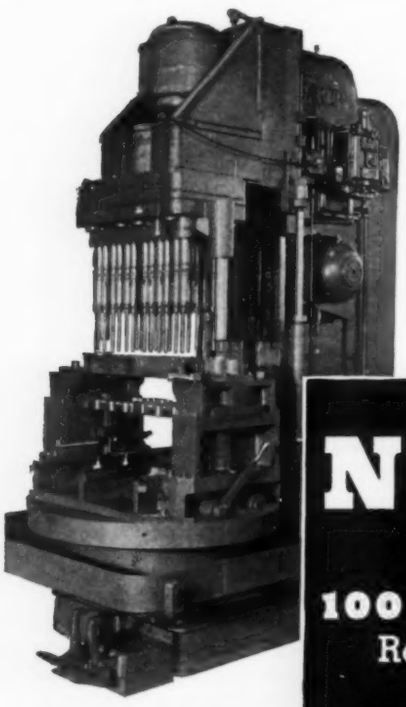
rately or jointly, demands constant performance-selection of taps, each is subject to criticism and the practice should be economically justified. By detail changes in design or processing of each of the pair of members making the threaded fits, performance selection usually becomes unnecessary. Efforts should be bent toward this end, recognizing, however, that upon rare occasions performance selection may be unavoidable. —R. V. HUTCHINSON.

The real test of a tap or any tool is simple—does it do the job? Are the resulting fits satisfactory?

All taps are now made oversize, because the manufacturer knows that when he hardens the tap it will shrink. Moreover, the tap will probably be ground. Theoretically, then after grinding, the tap is an acceptable commercial tool. But will it work?

Perhaps. The tap may be all right, but as often happens the capscrews or studs may be slightly undersize. It is quite common in an auto factory to find a car load of slightly undersize bolts or studs on hand, a job to be gotten out in a hurry, and tapped holes that are slightly large. Then, you have loose fits on your hands—too loose to pass. What is to be done? The answer is simple. Taps are few and small, capscrews and studs are many and bulky. It is common sense to fit the smaller to the greater, especially when time is a factor. Al is smart in making sure that he actually has a fit with the materials on hand before he goes into production.

—JAMES K. MATTER,
Industrial Engineer.



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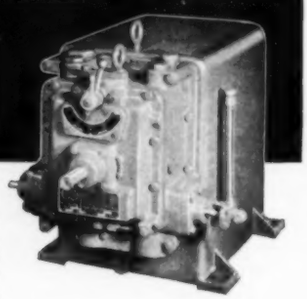


NEWS! News for machinery designers, sellers and buyers! The new Oilgear Fluid Power Feeds bring new speed, new smoothness, and new low cost. You should have the facts. Get them, in Oilgear's big new book. The OILGEAR Company, 1309 W. Bruce St., Milwaukee, Wisconsin.

Shown here: New Oilgear Fluid Power Feed. Note flanged mounting, as integral machine part... Inside pump, eliminating hazard and improving appearance... Self-contained; auxiliary valves and tubing are integral with pump... Many other exclusive features.

OILGEAR FLUID POWER FEEDS

[B-3500]

Change in Design

If I were in Al's shoes and the customer insisted on having a compressor built according to his specifications, I would build it so. If the changes should work out better than Al expects, all would be well. Al's point of hurting his reputation may be well taken, but if he builds the compressor according to the customer's idea, he should watch its performance closely. If it is not up to the standard of efficiency, he can easily show where it is wrong.

When acknowledging the order, the special features should be mentioned as having been designed as per instructions of the customer. Al may even learn something new from the customer.

Many times I have known of a customer's whim being carried out reluctantly, only to see it further developed later and turn out to be the foundation for something far better than the original product.

—J. C. P. BODE.

Standard designs should never be altered to satisfy the whims of customers. The customer's ideas may be an infringement on an existing patent and lead to costly litigation. One exception to the rule establishes a precedent and other exceptions will be inevitable. Special jobs disrupt work schedules and run up the costs of all jobs in process.

The better policy in cases of requests for special designs by customers is to let your competitor have the business, as such business is not worthwhile. The probability is that the customer whose change in design is refused will return to the fold at a later date, a shrewder buyer and a better prospect for future business.

—IRA S. WILLIAMS.

Hiring Older Men

In some respects the idea of retiring men at 45 had some foundation when the back-breaking requirements of former years was considered. Added to this were the long hours of toil that reduced to some extent the useful period of the individual. With modern methods and shorter hours the whole picture has changed. Personally, I believe that a man at 45 or 50 is more valuable than one at 25. The older man has the decided advantage in view of his experience.

Industry is leaning more and more on those who have the skill and experience. The concern that still holds that a man is old at 45 will find eventually that its product will suffer from lack of skilled hands. If something is not done in the near future about training our youth, industry will find itself with a host of untrained men. This situation is rapidly becoming a problem that will increase as the present 45-year-old skilled worker becomes incapacitated. —HAROLD L. WYNN,
Executive Engineer,
Pacific Electric Mfg. Corporation.

Tooling Up

Before tying up money in fixtures their complete cost should be considered. In addition to the cost of labor and material involved in their making, there is the idle production time of the machines used in testing them and in making trial runs, plus any material that may be spoiled before production is actually under way.

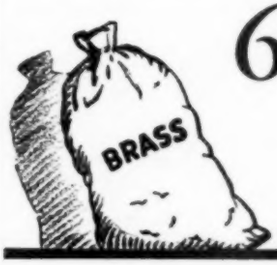
When the average life of a product is two years or more, and jigs and fixtures will save in direct labor the cost of getting into production and will make a better quality of product, they are warranted. Unless an executive knows the probable life of the model for which jigs and fixtures are wanted, he must gamble on the time in which they will pay for themselves.
—E. E. GAGNON.

One of the biggest problems in management is that of tooling up. Too many take Ed's attitude that saving labor cost is the only, or at least the main, thing to be considered. As he says, the pay roll comes up every pay day and that keeps it constantly before our eyes. Other costs, like interest on investment and depreciation, too frequently get lost in the shuffle.

Every good mechanic likes to see nice tools and new machines. But if he has to figure total costs as well as wages he is very apt to agree with Al in many cases. Broadly speaking there are only two reasons for investing in new machines or new fixtures. They either improve the product or save direct labor, and frequently they do both. Where direct labor is a large percentage of the total cost of the product, more money can be spent in tooling up than where the direct labor cost is low, when compared with the total cost.

In many cases it is cheaper to buy a good jig borer than to make a lot of fixtures for boring holes in work that is not made in large quantities. The cost of the jig borer is, of course, much greater than a few fixtures, but the jig borer can be used on such a variety of work that it pays.

Too many shop men go off half-cocked on the fixture question and tie up a lot of money that is never justified. As Al says, in effect, labor is frequently the cheapest thing in the shop, especially where the production is limited. —CHESTER H. FRANKLIN.



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SEEN AND HEARD

JOHN R. GODFREY

Service Charges Again

The old problem of free service crops up in various guises. One purchaser advises another to "put everything you want in the contract or you'll pay plenty for any extras." Tracing this back the seller found that the only disputed charge was not for parts furnished later but for the services of their erecting engineer who had to make several entirely unnecessary trips to the plant. Some purchasers seem to think they have the right to call for unlimited service and overlook that every trip costs money in both traveling expenses and salaries. And in addition they complain about the price charged for the machines they buy. The sooner machine builders of all kinds work out some equitable plan for charging for services rendered after the machine is installed the better for all concerned.

Roller Bearing Rods on Locomotives

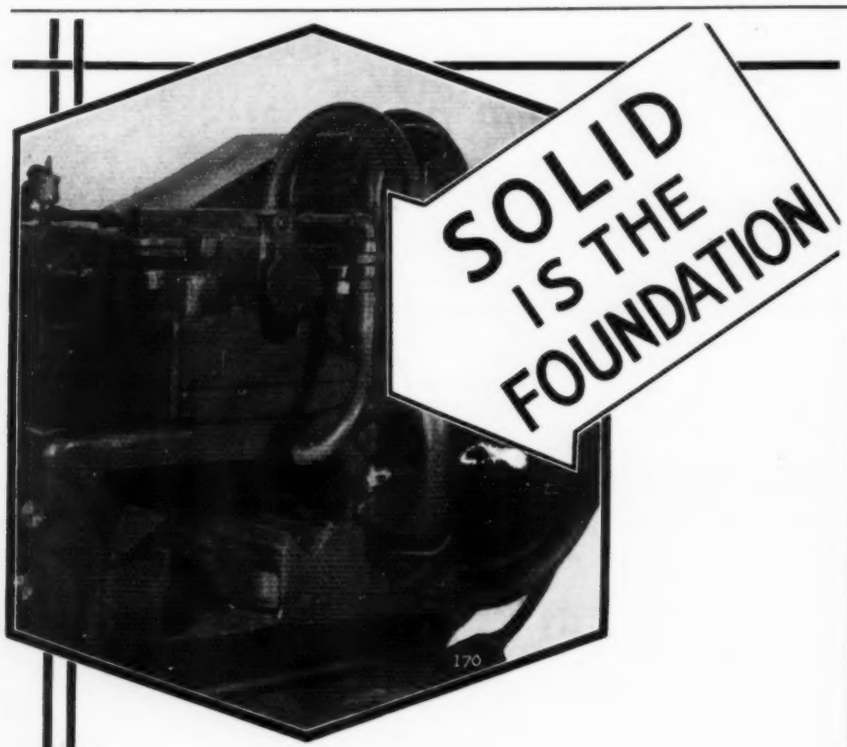
As was pointed out in a recent article in *American Machinist* the introduction of roller bearings on the new electric locomotives of the Pennsylvania Railroad has eliminated the old problem of driving boxes from the back shop. Now the Delaware & Hudson is trying out roller bearings, not only on the driving boxes but on the main rods and side rods as well. Railroads had previously cut out the adjustable rod bearings to a large extent by the use of floating bushings. So the next logical step is roller bearings. And with them should come freedom from much of the maintenance work that still lingers, even with floating bushings. With higher steam pressures and modern bearings, the newer steam locomotive should have a new lease of life.

Still Chances for Ingenuity

Anyone who thinks that mass production methods eliminate the need of old time ingenuity in the shop, should study almost any large shop getting into production on a new model. One little problem is how to light up the inside of automobile bodies while men are working in them. Drop lights or extension cords are O.K. on a stationary line but not so good when it is moving. Flash lights help but should be held by some simple clamp. They also have a habit of disappearing unless they are checked in and out of the tool crib by each shift. One bright idea was to fasten the flash light under a seat to be used by the man on the job. Some bright boy will find a better way than any of these.

Forgotten History

Unless one takes the trouble to do a bit of research work he is apt to go off half-cocked and say things he'd rather forget. As an example I read a statement that "prior to the introduction of carbide tools, no effort whatever was made to set up a standard for single point tools." This would be a complete surprise to Fred Taylor and a number of his co-workers. It was probably written by a young man who is enthusiastic over his work with carbide tools and with no thought of disparaging others. He simply was born too late to know of the work done so many years ago from personal knowledge.



No one questions the advantages of a solid foundation. In machine tool design this matter must be given serious consideration.

It has been on the new Landis Type C 15″x8″ Hydraulic Internal Grinder. First, the bed is of carefully webbed box type construction. Then, across its right-hand end is a sturdy bridge section supporting the wheel base. Because of the short rapid reciprocating strokes of the grinding wheel fixture, this solid foundation serves to dampen out practically all vibration generated.

How this improves work finish is quite fully described in catalog E-35. 192

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